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DEPARTMENT OF HEALTH FOR SCOTLAND

# NEO-NATAL DEATHS DUE TO INFECTION

The Report of a Sub-Committee of the  
SCIENTIFIC ADVISORY COMMITTEE

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## NEO-NATAL DEATHS DUE TO INFECTION

To THE SECRETARY OF STATE  
FOR SCOTLAND.

SIR,

I beg to submit, on behalf of the Scientific Advisory Committee, the Report of the Sub-Committee on Neo-natal Deaths due to Infection. This cause of death among infants in the first month of life is, in Scotland, responsible for at least ten per cent. of the total neo-natal mortality. But, although the part it plays is relatively small, its importance lies in the fact that these deaths are, for the most part, preventable.

The Sub-Committee directed its attention to the problem of infection among infants born in maternity hospitals, and concludes that, while infant care has steadily improved in recent years, there is, nevertheless, clear evidence that the standards of staffing and construction of infant nurseries should be revised. Control of infection depends primarily on staffing, in particular on the sufficiency and quality of the nursing staff. In addition, construction and equipment of the nurseries, especially in the larger hospitals, require careful planning.

It was found that premature babies are much more susceptible to infection than full-time infants. The Report, accordingly, touches upon the importance of prematurity as a predisposing cause of death from infection, and discusses briefly the bearing of social factors, in particular the state of nutrition of the expectant mother, on the complex problem of pre-natal and neo-natal mortality. In the Sub-Committee's view, prevention depends mainly on progressive education in the known principles of nutrition and on recognition of the necessity for high standards of obstetric care.

Finally, the Report urges the importance of continued research into the specific problem of infection, as well as the wider problem of the causation and prevention of neo-natal mortality in general.

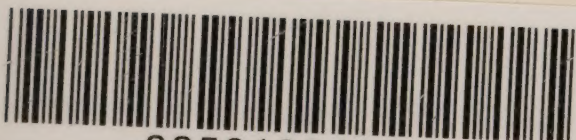
I am, Sir,

Your obedient Servant,

*A. S. Macgregor*

Chairman of Scientific Advisory  
Committee.

28th December, 1946.



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## CHAPTER I

## INTRODUCTION AND RECOMMENDATIONS

The Sub-Committee was appointed with the following terms of reference :  
 “ To consider the factors responsible for that part of infant mortality attributable to infection, with particular reference to the first month of life, and to suggest means for reducing mortality from this cause.”

The Sub-Committee had the great misfortune to lose the services of its Chairman, Professor James Hendry, during a long illness from which it was hoped that he would recover and be able to resume his duties. After his death, the work of the Sub-Committee was resumed, but we wish to record our great debt to him for the preparatory work carried through under his Chairmanship.

**Scope of the Report.**—The Orr Report on Infant Mortality in Scotland, issued in 1943, discusses the predominant part played by the infections among the causes of death during the first year. The general recommendations made in that Report, which have for their object improvement in nutrition, housing and standards of care of mother and child, apply with equal force to the protection of infant life during the neo-natal period—the subject of this Report. We shall have occasion to refer to certain of these recommendations.

Our remit, which is to consider that part of infant mortality attributable to infection, with special reference to the first month of life, follows directly from the reference to infections in maternity hospitals made in Chapter 3 of the Report on Infant Mortality in Scotland. It was there suggested that infection, as a direct or contributory cause of neo-natal mortality, was more common than was apparent, a suggestion borne out by the evidence of Professor Charles McNeil and Dr Agnes Macgregor (McNeil, 1942) based on a series of 225 post-mortem examinations of infants dying in the first month in the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, when 27 per cent. of the deaths were judged to be due to infection.

After giving other data on the incidence of infection, the relative paragraph concludes that “ since the tendency is towards an increase in the proportion of births in institutions, the problem is clearly one that calls for immediate investigation and for effective counter-measures.” We have, accordingly, restricted the scope of our inquiries and recommendations mainly to the more immediate practical problem of the incidence and prevention of infection among infants in maternity institutions. At the same time, as the problem is closely related to that of neo-natal mortality in general, we have, with the help of the Registrar-General for Scotland (Mr J. G. Kyd), expanded and brought up to date certain statistical information contained in the Report on Infant Mortality in Scotland, in so far as it bears on our remit.

The following is a summary of the contents of this Report :—

(1) As a statistical background to the Report, there is included a brief survey of neo-natal mortality in Scotland, with special reference to the distribution and volume of mortality due to infection, based on the returns of the Registrar-General and on special information provided by him.

(2) The experience of most of the maternity hospitals in Scotland is reviewed in respect of neo-natal mortality and its component parts, along with the incidence of still-births and of prematurity. The hospitals from which these rates were obtained are grouped to show the differences that exist according to their situation, whether in rural, semi-rural or industrial districts, and to the type of case admitted.



(3) The most reliable information available on the part played by infection is to be found in the records of maternity hospitals where post-mortem examinations, including microscopic examinations, are regularly carried out by pathologists of experience in this type of work. Accordingly, the Report contains an account of such examinations carried out at the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, and at the Aberdeen Maternity Hospital. These results are contrasted with those obtained where death certification rested mainly on clinical grounds

(4) As prematurity is an outstanding factor in death from infection as well as in neo-natal mortality generally, it was felt to be desirable to append to the Report a section on the more general question of the premature birth rate itself and the relation between prematurity and the health of the expectant mother. (Appendix 1.)

(5) As regards the management of infants in maternity hospitals and their protection from infection, the Report discusses and makes recommendations on the following :—(a) the nursery and the care of the infant, (b) nursery accommodation for healthy, sick and premature infants, (c) staffing of the nurseries and the training of nurses, and (d) the need for further investigation.

(6) Neo-natal infection in maternity institutions has been specially studied in recent years in this country and in America. In particular, the sources, mode of spread and the methods of prevention and control are fully and simply expounded in the Medical Research Council War Memorandum No. 11 on "The Control of Cross Infection in Hospitals," issued in 1944. Reference should be made to it for guidance and suggestions on the technical details of infant care. As this memorandum is recent and authoritative, we have not thought it necessary to cover the ground again beyond referring, in the text, to some of the more salient points.

**General Summary.**—The 1943 Report on Infant Mortality in Scotland included among its recommendations (a) more maternity beds, (b) more provision for premature infants, and (c) further investigation of neo-natal infections and stricter measures for their control. A substantial increase of maternity beds is one of the urgent problems of hospital provision ; existing institutions are subject to severe pressure on their beds, with its attendant dangers.

This Report deals with infection among infants in maternity hospitals and with the standards of infant care that should be aimed at in the nurseries. Infection as a cause of death is to be regarded as a major problem for the following reasons. First, it may be estimated that infection is responsible for a very considerable proportion of the deaths that occur towards the end of the first week of life and during the rest of the first month. It occurs during this period as a direct cause of death or in a latent form more frequently than is clinically apparent during life, as the Edinburgh, Aberdeen and Glasgow investigations clearly indicate. Second, the young infant possesses a relatively low capacity to resist invasion by certain organisms. Third, this vulnerability to infection is specially true of premature infants, among whom occur most of the deaths due to infection.

The prevention and control of minor and major infections in the nursery units of maternity hospitals are directly related to the degree of experienced care which the infant receives, both medical and nursing, and to the specific precautions enforced to avoid infection and to deal with it when it arises. The measure of greatest importance is the routine observance of an orderly and unhurried basic nursing technique by a staff adequate in number and quality. While good standards are the first essential, the nurseries should be so designed and equipped as to facilitate the work of the nursing staff, and to minimise, as far as is possible, the undoubted risks of cross-infection.



## RECOMMENDATIONS

Our recommendations are as follows :—

### Medical Staff

1. On the medical side, the care of all the infants should be the special concern of a physician experienced in the care of the new-born, acting in co-operation with the obstetrician. He should have charge of the special nurseries for sick and premature infants and for the isolation of infants suffering from infections. For the larger maternity hospitals and units, a pædiatric registrar should be appointed.

### Record Keeping

2. Careful day-to-day record keeping is of great practical value. While we do not think it desirable to lay down a detailed form of record, we consider that certain agreed basic records should be uniform for all hospitals, in order to further national and local studies of infant life.

### Annual Reports

3. Maternity hospitals should make a detailed annual report on the nursery side of their work.

### Mothercraft

4. Instruction in mothercraft begun during the pre-natal period should be continued while mother and child are still in hospital ; we realise the difficulties of doing this adequately under present-day conditions of pressure on accommodation and shortage of nursing staff.

### Co-operation

5. We attach much importance to co-operation between the hospital, the health visitor and the doctor in charge of the case. It would be helpful if the health visitor were to make contact with mother and infant, in certain cases before they leave the hospital, with a view to advising on precautionary measures in the home. It would also be advantageous for periodic meetings to take place between the senior midwife staff of the hospital and the health visitors of the district.

### Breast-Feeding

6. Every effort should be made in maternity hospitals to ensure that breast-feeding is practised to the fullest possible extent, the staff being trained with this object in view.

### Control of Infection, Bottle-Feeding, etc.

7. We have not thought it necessary to attempt to codify in detail the technical measures which should be adopted in the nurseries for the prevention and control of infection. These measures are fully explained in the Medical Research Council War Memorandum No. 11 on "The Control of Cross Infection in Hospitals." We concur in this Memorandum as a working basis.

8. A central milk kitchen for the preparation of artificial feeds should be provided in preference to individual ward kitchens.

### Nursery Accommodation

9. Opinions differ as to whether or not there should be a nursery for healthy infants. The Sub-Committee is divided on this point, some members preferring a nursery with a separate nursing staff. In any case, we recommend that the



large nursery should be avoided in favour of a suite of smaller wards, preferably containing from four to six cots each.

10. Special nursery provision is required (a) for sick infants and those requiring special treatment, (b) for premature infants born in the hospital and admitted from the district, and (c) for the isolation of infants suffering from infective conditions. We suggest that the accommodation under these heads should be for (a) 10 cots per 100 maternity beds, for (b) 10 cots per 100 maternity beds, and for (c) 5 to 10 cots per 100 maternity beds. Provision should be partly in wards holding 4 cots each and partly in the form of single cubicles.

11. We recommend that arrangements should be made, in central hospitals or units of the type referred to in Recommendation 1 above, for the admission of premature infants born at home when hospital care is necessary in the interests of the infant. It is, however, doubtful whether this facility could be provided at present on the scale required, as considerable additional cot provision would be necessary for a complete scheme. But it should be kept in view in connection with future extension of maternity provision.

12. The staff should be adequate in number and quality to secure continuity of skilled care and treatment by means of a permanent nucleus of trained nurses.

### Nursing Staff

13. We recommend that a ratio of 2 nurses to 3 cots ( $1$  to  $1\frac{1}{2}$ ) should be aimed at as a minimum in the nurseries.

14. While staffing arrangements will vary with the size of the hospital, we recommend the following standards for the larger maternity hospitals or units :—

15. There should be a basic permanent staff of trained nurses ; this is of special importance in the units for premature infants, sick infants and infected infants, where there should be a trained nurse always on duty and an experienced sister, or sisters, in charge. Where a nursery for healthy infants is provided, it should also have a trained nurse.

16. It would be advantageous if these nurses had general and sick children's, or general and fever training.

17. On this basis, at least one-third of the nursery staff would consist of permanent trained personnel, the remainder being trainees.

18. We draw attention to the value of employing nursery nurses, and suggest that consideration be given to their recruitment, where possible, as helpers in the nurseries with appropriate scales of remuneration.

### Training of Nurses

19. We consider that the training of nurses would be improved and their interest stimulated by some teaching in the special bacteriology of infant infections. The Medical Research Council Memorandum above referred to is a useful practical guide for the instruction of nurses.

20. We are of opinion that the practical care of the infant should receive greater emphasis than at present in the training course and in the examinations for pupil midwives for certificates or diplomas in midwifery, and suggest that representation be made accordingly to the Central Midwives Board for Scotland.

21. We also think it appropriate to suggest that part of the training of a Sick Children's Nurse might be obtained in the nursery of a maternity hospital or unit for a period of (say) three months. The General Nursing Council might be asked to consider this suggestion when the curricula for the training of nurses are being revised.



## Investigation and Research

22. Behind the more immediate practical questions with which the Report deals, there lies the wider and more intricate public health problem of neo-natal mortality, and its causation and prevention in the pre-natal stage, about which knowledge is still very incomplete. We consider that the problems pertaining to this phase of life require team work for their successful investigation and that joint studies by the clinical and laboratory staffs of maternity hospitals, along with those engaged in the ante-natal and domiciliary services (doctors, nurses and social workers) would be of great value.

23. There is need for more medical and laboratory investigation into the specific problems of the neo-natal period. We urge that pathological services and laboratory facilities, not only for the routine work of maternity hospitals, but also for fundamental research in co-operation with the medical staff should be made available under the re-organised laboratory service to be set up in Scotland.

24. Consideration of the prominent factor of premature birth, and of the allied problem of still-birth, emphasises the importance of good ante-natal care and an adequate diet during pregnancy ; and of a sufficiency of ante-natal beds in order to ensure that such skilled treatment as is required in the interests of mother and infant can be provided where domiciliary treatment is not feasible. (The larger question of prematurity is discussed in Appendix 1.)

## ACKNOWLEDGMENTS

We are greatly indebted to Mr Kyd, the Registrar-General for Scotland, and his staff for statistical information and tables placed at our disposal. As regards the care of infants in maternity hospitals, the standards of staffing and of nursing technique, the Sub-Committee invited oral and written evidence from Professor R. W. Johnstone, Visiting Obstetrician to the Edinburgh Royal Infirmary and Chairman of the Central Midwives Board for Scotland, Miss J. P. Ferlie, Matron of the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, and Mrs Thomas, previously Sister-in-charge of the Special Nursery, the Maternity Hospital, Aberdeen. In addition, the Sub-Committee had the benefit of individual contributions from its members.

Our special thanks are due to Dr G. B. Ludlam of the Bacteriology Department, University of Edinburgh, who prepared for us a very comprehensive review of the bacteriology of infections in infancy, including their epidemiology and immunology. Dr Ludlam prepared, at our request, a summary which is included in Chapter 6.

The services of Dr I. N. Sutherland, Medical Secretary, Scientific Advisory Committee, were freely given in many ways. He contributed Chapter 2 on Recent Scottish Statistics of Neo-natal Mortality.

The Sub-Committee deputed certain of its members to visit the following maternity hospitals in England :—Dudley Road Municipal Hospital, Birmingham ; Sorrento Maternity Hospital, Birmingham ; Queen Charlotte's Maternity Hospital, London ; the British Hospital for Mothers and Babies, Woolwich ; and St Helier County Hospital, Surrey. The members of the deputation have expressed their sense of indebtedness to the Medical Officers of Health of Birmingham, Surrey and Woolwich, to the Medical Superintendents, and especially to the clinical and nursing staffs of the hospitals visited, for much time and information freely given to the visitors.

We wish to express our indebtedness to Mr J. B. Swan, Department of Health for Scotland, for his able and willing assistance in the initial stages, and especially to Miss M. S. W. Campbell, his successor as Secretary to the Sub-Committee, whose competent and valuable services are gratefully acknowledged. We desire also to refer gratefully to the assistance given by Miss C. K. Duff.



## CHAPTER 2

RECENT SCOTTISH STATISTICS OF  
NEO-NATAL MORTALITY

The neo-natal mortality rate for Scotland during the years 1941 to 1943 was 35.91 per 1,000 live births. The amount of this rate attributable to infection is difficult to assess on the basis of death certificates. The rate due to pneumonia was 2.30 during the period, and that due to diarrhoea was 1.36, or together 3.66, a figure which amounts to 10 per cent. of the total mortality rate. On the assumption that certified causes of death are generally correct, a brief examination of Scottish statistics shows that certain environments are associated with lower rates, either from all causes or from individual causes; this being so, it may properly be argued that within the existing population of Scotland there is a capacity for lower neo-natal death rates, if only the more favoured environments can be transferred to other groups of the population.

Through the courtesy of the Registrar-General (Scotland) it has been possible to obtain neo-natal mortality rates from individual causes during 1941-3 in the major health authority areas, which include 33 counties and 24 large burghs. The Registrar-General has also provided tables, partly reproduced in his Annual Report for 1943, showing the total neo-natal mortality rates according to the social class of the father's occupation, for 1939, in Scotland, Edinburgh and Glasgow. In the following paragraphs the comments are limited to these data unless stated otherwise.

**Neo-natal Mortality Rate from All Causes.**—The rate (from all causes) is favourably affected by a county environment, as opposed to a burgh environment. The rate in all Scotland (35.91)\* would have to be reduced by 9.5 per cent. to bring it to equality with the county rate (32.50). Dividing the country into the Divisions used by the Registrar-General, the rate would have to be reduced by 18.1 per cent. to bring it to equality with that of the counties of the Northern Division (29.39). Had it, on the other hand, to be equated to the rate of the burghs of the West Central Division (41.74), it would have to be increased by 16.2 per cent.

Associations between rates at 1-11 months and indices of overcrowding and unemployment in burghs were discussed on pages 28-30 of the 1943 Report on Infant Mortality in Scotland. Neo-natal mortality rates for 1931-3, 1934-8 and 1941-3 do not show corresponding associations. It is not possible to state that improvement in these factors alone would lead directly to a fall in the gross neo-natal rates in Scottish burghs.

The data on social class show the definite ameliorating influence of higher class environment, which influence in the neo-natal period, though much less than in the post-neo-natal period, is considerable. The neo-natal rate in Scotland in 1939 would have had to be reduced by 30.3 per cent. to bring it to equality with that of Social Class 1. In the large burghs the corresponding reduction would have to be 46.2 per cent. and in the counties 7.6 per cent. Corresponding reductions for Glasgow, Edinburgh and the remainder of the large burghs would be 48.7 per cent., 25.2 per cent. and 56.2 per cent.

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\* For the sake of simplicity of narrative, the rate in all Scotland has been compared with rates in various constituent parts of the Scottish infant population. The method of presentation tends to lessen percentage differences in comparisons. It will be understood that the size of infant populations in various parts of the Scottish population is not uniform.



On the basis of the preceding paragraphs, it can be deduced that the neo-natal mortality rate yielded by the present population of Scotland is susceptible of improvement if environment can be brought nearer to that of children born in counties, especially those of the Northern Division, and in the better-off social classes. The data of the Registrar-General (Scotland), however, permit the argument to be carried further, as neo-natal deaths can be classified according to the certified cause of death.

**“ Possibly Infective ” Class.**—On making this further classification, the importance of a class of causes which has been designated “ possibly infective ” stands out. The class is that of deaths certified as due to convulsions, congenital debility and premature birth, and the reasons for stating their possibly infective status are indicated in a later section of this Report. To the total neo-natal mortality rate of 35·91 in Scotland in the period under study, convulsions contributed a rate of 0·45, congenital debility a rate of 3·54, and premature birth a rate of 14·94, making a total rate of 18·93 for this class of causes. These rates represent respectively 1·25 per cent., 9·86 per cent., and 41·59 per cent. (or a total of 52·7 per cent.) of the neo-natal mortality rate from all causes. The Scottish rate from this class of causes would have to be reduced by 5·5 per cent. to bring it to equality with the county rate of 17·88—a small reduction which is partly explicable by the facts that the county rate from convulsions (0·49) is 8·9 per cent. higher than the Scottish rate, and that the county rate from congenital debility (3·67) is 3·7 per cent. higher than the Scottish rate. When studied in the Divisions of the country, the general trend conforms to that already given for the neo-natal rate from all causes; the rate from convulsions, however, tends to be aberrant and, for instance, attains a figure of 0·53 in Northern Counties, where it is in excess of the Scottish rate by 17·8 per cent. Rates from congenital debility show a less decided aberrant trend.

The neo-natal mortality rates from the individual causes within this class do not differ significantly as between burghs and counties. They are not significantly associated with variations in the stated indices of overcrowding or unemployment in burghs. There is, in short, a numerically large class of deaths, designated “ possibly infective,” in which there is little evidence in the data studied that changes in those aspects of environment which can be assessed numerically would appreciably affect the rates. On the other hand, the data referable to Social Class given for England and Wales, and reproduced in Table B (Appendix 1), indicate that the death rate under one year from “ premature birth ” in Class V is twice that in Class I.

**“ Probably Infective ” Class.**—The next two causes studied as a class have been designated “ probably infective ”; this class includes deaths certified as due to pneumonia (including bronchitis) and diarrhoea. The respiratory part of this class contributed a rate of 2·30 and the alimentary part a rate of 1·36, representing respectively 6·41 per cent. and 3·79 per cent. (a total of 10·2 per cent.) of the neo-natal mortality rate from all causes. The Scottish rate from this class of causes would have to be reduced by 31·4 per cent. to bring it to equality with the county rate of 2·51. Counties of the Northern and Southern Divisions have rates of 1·85 and 1·78 from this class of causes, which are particularly favourable; the burghs of the West Central Division, with a rate of 5·1, have a very unfavourable experience.

The neo-natal mortality rates from the individual causes within this class are higher in burghs than in counties, the differences verging on formal significance. Neither cause is significantly associated with variations in the stated indices of overcrowding or unemployment in burghs. There is, in short, a fairly large class of deaths, designated “ probably infective,” which may be susceptible of improvement if environment, in those aspects which can be assessed numerically,



can be brought nearer to that of children born in counties, especially counties of the Northern and Southern Divisions.

**“ Probably Non-infective ” Class.**—The last class of certified causes of neo-natal death, designated “ non-infective,” comprises congenital malformations, injury at birth and “ all other causes,” the last being composite and known to contain a few deaths from infection, *e.g.*, from congenital syphilis. To the total neo-natal mortality rate, congenital malformations contributed a rate of 4·26, injury at birth a rate of 3·32 and “ all other causes ” a rate of 5·75, making a total rate of 13·33 for this class of causes. These rates represent respectively 11·86 per cent., 9·24 per cent., and 16 per cent. (or a total of 37·1 per cent.) of the neo-natal mortality rate from all causes. The Scottish rate from this class of causes would have to be reduced by 9·2 per cent. to bring it to equality with the county rate of 12·11. When tabulated by the Divisions of the country, the counties of the Northern and Southern Divisions, with rates of 11·26 and 11·9 respectively, have the most favourable experience.

The neo-natal mortality rates from the individual causes within this class are slightly, but not significantly, higher in burghs than in counties. Rates from congenital malformations are not significantly associated with the stated indices of overcrowding and unemployment. Rates from injury at birth and “ all other causes ” are significantly and *inversely* associated with the index of overcrowding, and inversely, but not significantly, with the index of unemployment. There is, in short, a numerically large class of deaths, designated as “ probably non-infective,” which may be susceptible of improvement if environment, in those aspects which can be assessed numerically, can be brought nearer to that of children born in counties, especially counties of the Northern and Southern Divisions. Within large burghs, however, the ameliorating influence of good housing and full employment on a large part of this class of deaths is dubious.

**Comment.**—It may be emphasised that the above survey of causes of neo-natal mortality, and in particular its conclusions, are subject to the important qualification that in a considerable proportion of deaths, the cause is erroneously certified. In the next chapter (see the section headed “ The Causes of Neo-natal Deaths ”), we employ more reliable data ascertained in hospital practice and based largely on pathological reports. The survey, however, shows—what is generally agreed—that the gross neo-natal mortality rate is less influenced by assessable environmental factors than is the rate at ages 1-11 months.

## CHAPTER 3

### NEO-NATAL DEATHS IN MATERNITY HOSPITALS

The preceding survey of neo-natal mortality in Scotland has shown that the rate is lower in the rural areas and higher in the more concentrated industrial areas, such as the south-west of Scotland. Much the same gradation applies to the death rate due to infections. In order to obtain some measure of these differences, information was collected from most of the maternity hospitals and units in Scotland. They were requested to give, for the four years' period from 1940 to 1943, the total live births, the still-births, and the premature live births (*i.e.*, 5 lbs. and under), the number of deaths of infants under 14 days, along with deaths ascribed to (*a*) birth injury, (*b*) malformations, (*c*) respiratory and (*d*) alimentary infections, and (*e*) prematurity for which no other cause could be given.



The rates calculated on the basis of these returns are shown in Table 1 (p. 14). The hospitals are grouped in accordance with a rough geographical and functional pattern; some of them, mostly with 30 beds or under, serve areas that are mainly rural, some serve mixed industrial and rural districts and others serve almost entirely industrial populations in the cities.

The war emergency maternity hospital group had, as might be expected, the most favourable experience because the cases admitted presented the fewest risks and also because the midwifery staff changed little, being non-mobile. Situated in country districts, these hospitals provided for expectant mothers selected at the ante-natal clinics in the cities as being unlikely to give rise to obstetric difficulties. These women were admitted well before the date of confinement, varying from one to four weeks. Thus, the mothers had the advantage of a period of nursing and organised residence before confinement combined with as good a diet as possible under war conditions. It will be noted in particular that the neo-natal mortality rate during the first fourteen days was only 10 per thousand births and that the rates for infections were the lowest in the series. This favourable mortality rate is largely due to the low death rate from prematurity, the reason being that, before the mothers were admitted, the pregnancy had advanced beyond the stage when premature birth was likely to occur.

As regards the other groups of hospitals, the neo-natal mortality rate (for the first 14 days of life) varied from 21.5 to 52.2 per thousand live births; of this gross rate, the rates ascribed to prematurity varied from 10.5 to 26.3, and those from respiratory infections varied from 1.4 to 3.9, while those from alimentary infections varied from 0.2 to 2.3 per 1,000 live births. The total mortality rate from these infections, as certified, amounts to approximately 10 per cent. of the neo-natal mortality rate (for the first 14 days of life) over very large numbers of live births. The proportion of premature births to total live births varied, in these groups of hospitals, from 3.98 per cent. to 12.75 per cent. In the hospitals visited in England by members of the Sub-Committee, more or less selected cases were dealt with, and the neo-natal mortality rate for the first 14 days varied from 13.4 to 28 per 1,000 live births, while the proportion of premature births varied from 4.7 per cent. to 10 per cent. Infection apparently contributed little to neo-natal death.

It will be obvious that these gradations depend mainly upon the kind of obstetric case with which the hospitals are called upon to deal. The larger hospitals in the towns and the city hospitals which are medical teaching schools admit abnormal cases in varying proportions. For instance, selection of cases in this sense reaches its height in the latter group of hospitals, where at present about 75 per cent. of the admissions are obstetrically abnormal cases. These factors largely account for the relatively higher rates for still-births, premature births, malformations, birth injuries and the total neo-natal death rate. The rate for respiratory and alimentary infections rises with urbanisation.

This broad survey of the functions and practice of the maternity hospitals of the country shows how much the results depend on the material that is brought to them. Most of them, particularly those in the larger industrial areas, are working under high pressure and with staffing arrangements which do not permit the best possible results to be obtained.

**The Causes of Neo-natal Deaths as disclosed by two series of investigations in Edinburgh and Aberdeen.**—Two studies of the causes of neo-natal deaths based on the results of post-mortem examination were made available to the Sub-Committee by Dr Agnes Macgregor and by Professor Dugald Baird. These two series of investigations are summarised in the following paragraphs.



TABLE I  
*Births and Deaths in Maternity Hospitals in Scotland, 1940-1943*

	DEATHS UNDER 14 DAYS									
	No. of Live Births (1)	No. of Still Births (2)	Still-Birth Rate per 1,000 Births (Live and Still) (3)	Premature Birth Rate per 1,000 Live Births (4)	Neo-natal Death Rate per 1,000 Live Births (5)	Birth Injury Death Rate per 1,000 Live Births (6)	Death Rate due to mal-formations per 1,000 Live Births (7)	Respiratory Infections Death Rate per 1,000 Live Births (8)	Alimentary Infections Death Rate per 1,000 Live Births (9)	Death Rate ascribed to prematurity per 1,000 Live Births (10)
Emergency Maternity Hospitals ... ..	4,049	86	20.8	28.1	10.1	3.0	2.0	1.0	0.2	2.5
Hospitals with 30 beds or under (mainly rural areas) ... ..	9,212	346	36.2	39.8	21.5	4.9	2.9	1.4	0.2	10.5
Hospitals with over 30 beds (mainly urban areas) ... ..	25,117	1,110	42.3	73.7	32.8	5.3	4.1	2.5	1.2	16.4
Local Authority Hospitals with over 30 beds (Cities) ... ..	24,393	1,160	45.4	69.6	42.5	6.7	3.1	1.9	1.2	23.6
Hospitals with over 30 beds (mainly mining areas) ... ..	14,563	1,019	65.4	101.1	46.8	7.8	3.6	1.9	2.3	25.1
Royal Infirmaries (not medical student teaching)	4,179	261	58.8	114.6	44.5	5.5	5.5	2.9	1.0	26.3
Medical Student Teaching Institutions	27,380	2,435	81.7	127.5	52.2	16.1	5.7	3.9	1.2	20.6



*The First or Edinburgh Series*

The causes of death of 618 infants ascertained on post-mortem examinations carried out at the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, by Dr Agnes Macgregor, are shown in Table 2, the period covered being from 1939 to 1943 inclusive. The figures include all the cases dying in the hospital, with a few exceptions where the lethal condition of gross congenital defect made autopsy unnecessary. They also include a number of deaths of infants admitted to hospital after birth, on which post-mortem examinations were made.

All the autopsies were carried out by or under the supervision of one pathologist, and included microscopical examinations where necessary. In the table, the cases are arranged according to the condition that was judged to be the principal cause of death. The deaths referable to the several conditions are tabulated according to the week in which they occurred. Mature and premature infant deaths are shown separately.

*The Second or Aberdeen Series*

The causes of death of 217 infants born in the Aberdeen Maternity Hospital during the three years 1941 to 1943 are summarised in Table 3, submitted by Professor Dugald Baird. These figures are based on post-mortem examinations carried out under the supervision of Professor John Young. The total infant deaths during the period were 274, those not submitted to post-mortem examination including 36 small premature babies dying within 48 hours of birth and 21 who died after the second day, 13 from gross deformity and 8 from prematurity.

[TABLE 2.]



TABLE 2

*Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh :  
Age Distribution of 618 Cases of Infant Deaths from Various Causes for  
Five Year Period 1939-1943*

	Day of Death			1st Week	2nd Week	3rd Week	Remainder of Month to 31st Day	Total
	-1	-2	-3 to -7					
<i>Developmental Malformations :</i>								
Mature ...	8	11	18	37	4	1	—	42
Premature ...	14	2	5	21	1	1	—	23
Total ...	22	13	23	58	5	2	—	65
<i>Intra-cranial Haemorrhage :</i>								
Mature ...	12	11	6	29	2	—	—	31
Premature ...	97	16	20	133	6	1	—	140
Total ...	109	27	26	162	8	1	—	171
<i>Asphyxia :</i>								
Mature ...	11	2	1	14	—	—	—	14
Premature ...	55	9	3	67	—	—	—	67
Total ...	66	11	4	81	—	—	—	81
<i>Infective Diseases :</i>								
Mature ...	1	6	13	20	23	14	7	64
Premature ...	4	11	27	42	42	30	12	126
Total ...	5	17	40	62	65	44	19	190
<i>Miscellaneous Conditions:</i>								
Mature ...	4	4	8	16	4	3	1	24
Premature ...	10	4	8	22	2	1	—	25
Total ...	14	8	16	38	6	4	1	49
<i>Inconclusive Autopsy :</i>								
Mature ...	—	1	2	3	1	1	2	7
Premature ...	31	8	11	50	2	3	—	55
Total ...	31	9	13	53	3	4	2	62
<i>Total :</i>								
Mature ...	36	35	48	119	34	19	10	182
Premature ...	211	50	74	335	53	36	12	436
Total ...	247	85	122	454	87	55	22	618
<i>*Infections concurrent with non-infective Diseases :</i>								
Mature ...	2	4	3	9	3	—	—	12
Premature ...	7	8	7	22	1	—	—	23
Total ...	9	12	10	31	4	—	—	35

\* These figures represent cases in which infections were present but secondary to the principal cause of death. They are included in the totals under the respective principal cause of death.



TABLE 3

*Aberdeen Maternity Hospital :  
Age Distribution of 217 Infant Deaths from Various Causes for  
Three Year Period 1941-1943*

	Day of Death			1st Week	2nd Week	3rd Week	Remainder of Month to 31st Day	Total
	-1	-2	-3 to -7					
<i>Developmental Malformations :</i>								
Mature ...	3	3	2	8	2	2	—	12
Premature ...	3	—	—	3	1	—	1	5
Total ...	6	3	2	11	3	2	1	17
<i>Intra-cranial Haemorrhage :</i>								
Mature ...	12	8	3	23	1	—	—	24
Premature ...	5	4	3	12	—	—	—	12
Total ...	17	12	6	35	1	—	—	36
<i>Asphyxia :</i>								
Mature ...	7	1	1	9	—	—	—	9
Premature ...	61	11	13	85	3	1	—	89
Total ...	68	12	14	94	3	1	—	98
<i>Infective Diseases :</i>								
Mature ...	—	—	1	1	2	6	1	10
Premature ...	—	—	2	2	10	10	3	25
Total ...	—	—	3	3	12	16	4	35
<i>Miscellaneous Conditions:</i>								
Mature ...	1	—	2	3	—	1	—	4
Premature ...	2	1	4	7	2	—	—	9
Total ...	3	1	6	10	2	1	—	13
<i>Inconclusive Autopsy :</i>								
Mature ...	—	—	2	2	1	—	1	4
Premature ...	7	1	3	11	2	1	—	14
Total ...	7	1	5	13	3	1	1	18
<i>Total :</i>								
Mature ...	23	12	11	46	6	9	2	63
Premature ...	78	17	25	120	18	12	4	154
Total ...	101	29	36	166	24	21	6	217
<i>*Infections concurrent with non-infective Diseases :</i>								
Mature ...	—	—	—	—	2	1	—	3
Premature ...	—	—	1	1	3	2	1	7
Total ...	—	—	1	1	5	3	1	10

\* These figures represent cases in which infections were present but secondary to the principal cause of death. They are included in the totals under the respective principal cause of death.



The important points that emerge from these results are :—

(a) *Part played by Infection.*—In the first series 30·7 per cent. of the total deaths (190 out of 618) were ascribed to infection ; in the second series deaths due to infection were 16·1 per cent. of the total (35 out of 217). The figures shown at the foot of Tables 2 and 3 represent cases where grave infection was found to be present, although not the primary cause of death. When these figures are taken into account, the incidence of infection found on autopsy was 36·4 per cent. in the first series and 20·7 per cent. in the second series. (It may be noted that, as most babies are discharged from hospital before the end of the second week, the figures for the second half of the period do not truly represent the amount of fatal infection that occurs during that time, as it is not known how many of those discharged died before the end of the neo-natal period.) A survey by Cruickshank (1930) of 800 neo-natal deaths in a maternity hospital showed that 29·75 per cent. were due to infection, other causes such as asphyxia, atelectasis, birth injury, prematurity and gross developmental defects accounting for the remainder.

(b) *Age incidence of Death due to Infection.*—Deaths from infection are distributed over the neo-natal period. The other principal causes of death—extreme prematurity, malformations, intra-cranial hæmorrhage, asphyxia—destroy life during the first few days, and especially during the first two days after birth. In the first series, some 22 cases are recorded as dying of infection—mainly pneumonia—within 48 hours of birth, but, having regard to the circumstances surrounding these early deaths from pneumonia, they do not belong to the same category as those which occur later in the first month of life. Ignoring the first 48 hours, during which time the deaths from infection were few in the first series and nil in the second series, the proportion which death from infection bore to that from all causes was 58·7 per cent. and 40·2 per cent. respectively. When grave infections associated with other causes of death are further included, the incidence of infective conditions becomes 63·6 per cent. in the first series and 51·7 per cent. in the second series. The distribution of the deaths due to infection over the first month is summarised in the following table :—

TABLE 4  
*Distribution of Deaths—3rd to 31st Day (inclusive)*

	First 2 Days	1st Week	2nd Week	3rd Week	Remainder of Month to 31st Day	Total
<i>First Series :</i>						
Deaths from Infection	22	62	65	44	19	190
Total Deaths ... ..	332	454	87	55	22	618
<i>Second Series :</i>						
Deaths from Infection	—	3	12	16	4	35
Total Deaths ... ..	130	166	24	21	6	217

This table shows that most of the deaths from infection are referable to the period from the end of the first week to the end of the first month of life.

(c) *Infection in Relation to Prematurity.*—The relation between prematurity and death from infective conditions is well illustrated. Discarding deaths during



the first 48 hours, the following table shows the extent to which prematurity influences death from infection :—

TABLE 5  
*Deaths due to Infection—3rd to 31st Day (inclusive)*

	FIRST SERIES		SECOND SERIES	
	Total Deaths	Deaths due to Infection	Total Deaths	Deaths due to Infection
Mature ... ..	111	57	28	10
Premature ... ..	175	111	59	25
Total ... ..	286	168	87	35

In the first series, 66 per cent. of the deaths due to infections were of premature infants, the corresponding figure being 71 per cent. in the second series. Of the total deaths of premature infants occurring after the second day, 63 per cent. were due to infection in the first series and 42 per cent. in the second series. Infection is thus a major cause of death among prematurely born infants.

(d) *Neo-natal Mortality and Prematurity.*—The results outlined above show the importance of premature birth as a factor in neo-natal mortality in hospitals. In the first series of 618 deaths, 436 or over 70 per cent. of the infants were premature, 211 dying within the first 24 hours after birth and 335 within the first week of life. In the second series of 217, the proportion of premature infants was the same, just over 70 per cent. Parsons (1944) points out that in Birmingham, during the four years 1938-1941, when there were 70,402 live births, 54 per cent. of the neo-natal deaths were of premature infants.

**Comparison with Other Hospitals.**—Returns from hospitals where the death certification depended mainly on clinical grounds were requested for the five-year period 1939-1943, and the information received is summarised in Table 6. In these hospitals, post-mortem examinations had been interrupted during the war or pathological services were only partially available. In the first hospital (Hospital A), a medical training school in Glasgow, the proportion of the deaths clinically attributed to infection to the total deaths during the neo-natal period from the 3rd to the 31st day was 32·4 per cent. In a group of municipal hospitals, also in Glasgow (Hospital Group B), the figure was 21·6 per cent. over the same period. The first hospital admits a much higher proportion of emergency cases than do the latter hospitals.

TABLE 6  
*Deaths due to Infection (Clinical Series)—3rd to 31st Day (inclusive)*

	HOSPITAL A		HOSPITAL GROUP B	
	Total Deaths	Deaths due to Infection	Total Deaths	Deaths due to Infection
Mature ... ..	148	53	177	69
Premature ... ..	368	114	351	45
Total ... ..	516	167	528	114

In Hospital A, 68 per cent. of the infants who died of infective conditions after the second day were premature, while in Hospital Group B the figure was 39 per cent. Taking the deaths as a whole, prematurity was present in 71 per cent. and 66 per cent. respectively. This coincides with the figures given for the hospitals previously studied. Thus, in the large series of neo-natal deaths analysed, 7 out of every 10 were premature infants.



Further information relating to maternity hospitals in Glasgow was provided by Dr S. Graham and Dr Nora Wattie. A table prepared by the former in respect of the five-year period 1939 to 1943 contrasts the results of post-mortem and clinical diagnosis as follows :—

TABLE 7  
*Royal Maternity Hospital, Glasgow—Infant Deaths 1939–1943*

	Total Number of Deaths	Deaths due to Infection	Percentage
<i>First Month :</i>			
Post-mortem diagnosis ...	618	225	36·4
Clinical diagnosis ...	1,006	177	17·6
<i>First Week :</i>			
Post-mortem diagnosis ...	454	93	20·5
Clinical diagnosis ...	716	61	8·5
<i>First Three Days :</i>			
Post-mortem diagnosis ...	377	58	15·4
Clinical diagnosis ...	545	19	3·5

Throughout the first month of life, post-mortem examination revealed an incidence of infection twice as great as that found on clinical examination.

In a further series of 1,090 deaths occurring during the first month in four Glasgow Municipal Hospitals, where diagnosis rested on clinical grounds mainly, infection was diagnosed as a cause of death in 116, or only 10·6 per cent. of the total as compared with 17·6 per cent. in the above series.

An investigation into the causes of death of 272 infants under one year of age in Newcastle throughout 1939 was carried out by Spence and Miller (1941), who estimated that “ the recorded cause of death gave an inaccurate or inadequate description of the actual cause in one-third of the cases.” Of these, 138 were neo-natal deaths, prematurity (alone) accounting for 47 ; in the whole series, 78 or 28·6 per cent. were premature infants, born of 73 mothers.

**Fatal Infections in Mature and Premature Infants.**—The mortality rate due to infection in the hospitals studied has been calculated for mature and premature infants respectively.

In the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, during the years 1939-43, there were 11,763 live births of mature infants, of which 63 died of infective conditions in hospital (5·4 per 1,000 mature live births), and 1,232 live births of premature infants, of which 97 died of infective conditions in hospital (79 per 1,000 premature live births). In Aberdeen Maternity Hospital, during the years 1941-43, there were 4,350 live births of mature infants, of which 10 died of infective conditions in hospital (2·3 per 1,000 mature live births), and 545 live births of premature infants, of which 25 died of infective conditions in hospital (46 per 1,000 premature live births). In the Royal Maternity Hospital, Glasgow, in the same period, there were 7,585 live births of mature infants, of which 43 died of infective conditions in hospital (5·7 per 1,000 mature live births), and 1,246 live births of premature infants, of which 93 died of infective conditions in hospital (75 per 1,000 premature live births). Similarly, in the maternity units of the four Glasgow Corporation Hospitals in the period 1939-43, there were 20,913 live births of mature infants, with 71 deaths caused by infections in hospital (3·4 per 1,000 mature live births), and 1,527 live births of premature infants, of which 45 (29 per 1,000 premature live births) died in hospital from infective causes.



**Comment.**—The chief difference between these studies of neo-natal mortality in individual hospitals lies in the fact that, where habitual resort is made to pathological facilities in determining the cause of death, infection is found to be a more common factor responsible for, or contributing to, a fatal issue than is the case where diagnosis rests upon clinical grounds alone. It may be inferred that a high standard of accuracy in clinical diagnosis is not to be expected even under the best circumstances, and that, apart from certain obvious causes of death, the degree of error is considerable. Returns from hospitals where pathological examination was not the regular procedure contained a high proportion of deaths grouped under such vague headings as miscellaneous, congenital debility, prematurity, whereas in those hospitals where routine autopsy was practised, the cause of death could be correctly stated in all but some 10 per cent. As regards death certification in general, the simple classification prescribed by the Registrar-General is not always followed, a source of confusion when the causes of neo-natal mortality are being compiled and studied.

## CHAPTER 4

### TYPES OF NEO-NATAL INFECTION

The types of infection comprising the heading “ Infective Diseases ” in the first, or Edinburgh, series and in the second, or Aberdeen, series (see previous Chapter) are set out in the following table :—

TABLE 8  
*Neo-natal Deaths due to Infection—3rd to 31st Day (inclusive)*

	Pneu- monia	Gastro- enter- itis	Severe Thrush	Menin- gitis	Septi- cæmia and Pyæmia	Syphi- lis	Total
<i>First Series :</i>							
Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, 5 Years 1939-43							
Mature ... ..	28(8)	20	6(3)	5	4	—	63
Premature ... ..	71(7)	25	13(2)	4	5	1	119
Total ... ..	99(15)	45	19(5)	9	9	1	182
Percentage ... ..	54·4	24·7	—	—	—	—	—
<i>Second Series :</i>							
Aberdeen Maternity Hospital, 3 Years 1941-43							
Mature ... ..	8(1)	2	1	2	—(1)	—	13
Premature ... ..	21	2	4(1)	1	3(3)	1	32
Total ... ..	29(1)	4	5(1)	3	3(4)	1	45
Percentage ... ..	64·4	8·9	—	—	—	—	—

*Note.*—The figures include cases, shown in brackets, in which a secondary infection was present though not the principal cause of death.



**Incidence of the Infections.**—The commoner lethal infections were those of the respiratory tract, nearly always pneumonia, and those of the gastro-intestinal tract, including gastro-enteritis and severe thrush (œsophageal and gastric). Other infections (meningitis and septicæmia, including umbilical sepsis) accounted for relatively few deaths. Congenital syphilis was a rare cause.

Pneumonia was responsible for most of the mortality, and was most frequently present as a secondary cause of death in the first series. Deaths from pneumonia showed a fairly even distribution throughout the whole month. Gastro-enteritis caused no fatalities before the seventh day, and had its greatest incidence during the second and third weeks. Calculations based on the first series show that the mean age at death from pneumonia was 10·84 days, from gastro-enteritis 16·58 days, from thrush 15·58 days, from meningitis 9·4 days, and from septicæmia 7·8 days.

**Note on Neo-natal Pneumonia.**—Dr Agnes Macgregor contributes the following note on pneumonia :—

“As certain types of pneumonia are characteristic of, or even peculiar to, the neo-natal period, a brief reference is made to these varieties—

(a) Pneumonia causing death in the first week, and in particular during the first three days, usually affects lungs in which an abnormal condition has developed as a result of birth stress, such as atelectasis due to the respiratory depression that accompanies severe asphyxia, or a water-logged state due to excessive aspiration of liquor amnii, which often occurs in cases of foetal asphyxia. The foetus may be infected before or during birth from the maternal passages, or after birth from any environmental source, the infection finding a ready foothold in the abnormal lung tissue. The prevention of this type of pneumonia lies chiefly in the obstetrician's field, as it depends on the prevention or effective treatment of birth asphyxia.

(b) Septic aspiration pneumonia is due to inhalation either of milk during feeding, or of regurgitated stomach contents. It is characterised by a severe destructive inflammation in and around the bronchi, often going on to suppuration. It is a feature of the neo-natal period, being met with much less often in older infants; it is common in the newly-born, and is a risk to be kept in mind in the feeding and nursing of infants.

(c) Staphylococcal pneumonia is commoner in the neo-natal period than at any other time of life. It produces a rapidly developing suppuration, beginning in the bronchi, from which it spreads to involve large areas of the lungs in total disorganisation. It is sometimes caused by septic aspiration and sometimes arises from infection transferred from without, and may appear in association with outbreaks of other forms of staphylococcal infection in the nurseries.

(d) Broncho-pneumonia, due to air-borne infection originating in the upper respiratory tract or bronchi, has the same pathological features as broncho-pneumonia in older infants. It may be caused by the common pathogenic organisms of the respiratory tract—*streptococcus hæmolyticus*, *pneumococcus*, *H. influenzae*. In the neo-natal period, however, it is not infrequently due to infection with common organisms that do not cause pneumonia in older subjects, notably those of the *B. coli* group.”

Parsons (1944) points out that “the importance of pneumonia is not generally recognised owing, doubtless, to the difficulties in making a diagnosis and in recognising post-mortem lesions; moreover, pneumonia, though an important factor, may not be the sole cause of death.” The clinical picture tends to be negative and confusing. It is negative because in most cases there is absence of cough, obvious dyspnoea and fever; it is confusing when the presence of cyanosis suggests asphyxia or intra-cranial hæmorrhage. The majority of fatal pneumonic infections occur in premature infants and are closely related to early faults in the



functioning of the lung. There is much need for further study of respiratory infections in the new-born.

**Epidemic Diarrhoea of the New-Born.**—Outbreaks have been described in American hospitals by several authors—Barenberg *et al* (1936), Rice *et al* (1937), Frant and Abramson (1937 and 1938), Best (1938)—with aggregate case mortalities varying from 42 to 47 per cent. In four Canadian hospitals, the case mortalities were 40 per cent. (McClure, 1943).

Three outbreaks in hospitals in England are described by Ormiston (1941) with an aggregate case mortality of 29 per cent. ; hospital A had 27 cases and 5 deaths ; hospital B, 83 cases and 25 deaths ; hospital C, 29 cases and 11 deaths ; Gairdner (1945) describes 47 cases in a maternity unit with 31 deaths occurring sporadically and in small groups over a period of 13½ months. In the nursery of a maternity unit, gastro-enteritis “ was a considerable problem ” with 5 fatal cases as compared with another unit in the same city where only one case occurred, a difference attributed to better technique (Corner, 1946).

In Scotland, outbreaks have been described by Craig (1936), Graham (1939) and by Henderson (1943). Outbreaks are known to have occurred as follows :—Hospital A, 73 cases and 18 deaths in 1943 ; hospital B, 41 cases and 19 deaths in 1942 (unpublished data) ; hospital C, a small outbreak in 1938 with 9 cases and 7 deaths associated with a staphylococcal rhinitis (Bloch, 1941). Professor McNeil, in a note to the Sub-Committee, quotes his experience at the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh, during the four years 1940-1943, when 137 cases occurred with 64 deaths, due either to the original infection or to superadded acute pneumonia. Of these cases, 59 occurred in premature babies and 78 in full-term infants, the case mortalities being 57·6 per cent. in the former group and 38·4 per cent. in the latter group. The case incidence was 0·7 per cent. among the mature infants and 7 per cent. in the premature infants. Symptoms of onset were not noted in any case before the third day, but the onset occurred in one-third of all the cases from the third to the seventh day.

In Ormiston's series of cases of gastro-enteritis, he found that, in outbreak B, 14 per cent. of 51 sick infants who were entirely breast-fed died, as contrasted with 60 per cent. of 30 infants who were artificially fed with or without breast milk. In outbreak C, all were being bottle-fed with cow's milk mixtures when they developed the disease, and the case mortality was 38 per cent. This is one example, among many, of the capacity of the breast-fed infant to resist infection, in whom it is less frequent and less severe. As regards infection generally, Ludlam and Henderson (1942) say that “ both latent and clinical infections are three to four times more frequent among artificially-fed than among breast-fed babies, probably associated with the greater risks of infection from bottles, teats, nurses' hands and the like.”

**The Minor Infections.**—The new-born infant does not appear to possess a developed resistance to organisms which are commonly found as saprophytes on the adult skin and mucous membranes. In particular, staphylococcal infections of the skin may take the form of small localised “ septic spots ” or vesicles, umbilical lesions, paronychia or boils, and may give rise to conjunctivitis. A danger to the affected child is that a mild skin infection may become acute or generalised, developing into more serious conditions such as bullous impetigo, dermatitis, pemphigus, or into a rapidly fatal septicæmia. A danger to the other infants in the nursery is the possible spread of these surface infections in the form of outbreaks, an occurrence which is not uncommon. Consequently, the earliest sign of such a surface infection, however slight, should be watched for and noted, in order that preventive treatment can be undertaken at once.

As regards the incidence of all forms of infection, Professor McNeil, in a personal communication, gives a figure of approximately 20 per cent. among 13,309



infants at risk over a period of five years from 1939 to 1943, in the Simpson Memorial Maternity Pavilion, Royal Infirmary, Edinburgh. The commoner sites of infection were—the conjunctiva (6·6 per cent.), the skin (5·6 per cent.), the upper respiratory tract (thrush, 4·6 per cent.), and the lower respiratory tract (pneumonia, 1·4 per cent.). In a maternity hospital in England, Corner (1946), reporting on the incidence of infections of all descriptions, however slight, quotes a figure of 25·3 per cent. of all babies in one hospital and 29·7 per cent. in a second hospital. The most common sites were the conjunctiva, the skin and the mouth and nose. The experience of those in charge of the maternity unit of the St Helier County Hospital was given to the members of the Sub-Committee who visited the hospital. Here, the incidence of minor nursery infections was 21 per cent. among 1,293 deliveries in 1945, “sticky eyes” being much the most frequent. It was pointed out that, during the first four months of 1946, the number of these cases had been halved as the result of the prophylactic use of penicillin.

## CHAPTER 5

### DISCUSSION OF PROBLEM

It is shown in Table 1 that the mortality rate among infants in maternity hospitals during the first fourteen days after birth is higher in urban than in rural and semi-rural areas, and that the rate for infections tends to follow much the same gradation. Respiratory infections being most prevalent in large industrial communities, hospitals which serve them are in consequence more exposed to the risk of introduction of infection from without. From our inquiries, it was apparent that respiratory diseases were more frequent in hospitals in the northerly parts of Great Britain. Further, most maternity hospitals at present are working under sustained pressure on their accommodation, with a tendency to overcrowding and understaffing.

The guiding principles of infant care in maternity hospitals have been studied and expounded and more or less applied in recent years, with the result that substantial improvements have been made since the time when the care of the infant was secondary to that of the mother. There is evidence that this improvement has continued following the publication of the 1943 Report on Infant Mortality in Scotland, in spite of present-day difficulties of accommodation and staffing.

Nevertheless, there is room for further improvement. It is difficult to assess results in different hospitals without taking into account their special handicaps, but whatever the difficulties, it is true to say that the best results are reached in hospitals where most attention is devoted to the quality and adequacy of the nursing staff and to the adoption of a sound basic nursing technique in the care of the infants. For instance, a recent report on the experience of two maternity units in the same city in England revealed an infection death rate of 0·89 per 1,000 live births in the first and 3·76 in the second unit, a difference attributed to better nursing standards in the first hospital, although the incidence of infection of all kinds, however slight, was 25·3 per cent. of all the babies (Corner, 1946). Protection from infection is primarily a question of a good régime applied by nurses with special knowledge and training in the art of prevention. This ideal can be realised only if there is a nucleus of permanent trained staff in the nurseries. Few hospitals have attained to the standards of quality and adequacy of staff now regarded as desirable.

The hospitals specially studied for the purposes of this Report belong to the last group in Table 1, which had an over-all mortality rate of 3·9 per 1,000.



births from respiratory diseases and a rate of 1·2 per 1,000 births from intestinal infections. These figures, which are slightly less than the total death rate from infection, are small when compared with the neo-natal mortality as a whole. But, as has been shown, they understate the part played by infection.

Infection occurs as a cause of death or as a contributory cause more frequently than is apparent from hospital returns, judging by the evidence afforded by pathological investigation. Two series of consecutive records of this kind were supplied from hospitals in Edinburgh and Aberdeen, and for comparison a similar series was obtained from hospitals where death certification was based mainly on clinical grounds. The points that emerge from the figures supplied include the following :—

(a) Of the total cases dying during the first month of life, post-mortem examination revealed that 30·7 per cent. were attributable to infection in the first or Edinburgh series and 16·1 per cent. in the second or Aberdeen series. In a further large group from the Royal Maternity Hospital, Glasgow, 36·4 per cent. of the deaths were regarded as due to infection disclosed by post-mortem examination, as compared with 17·6 per cent. of those that were certified on clinical observation alone.

(b) Omitting the deaths during the first 48 hours after birth, when acquired infection is small and other causes predominate, the deaths due to infection occurring during the 3rd to the 31st day were 59 per cent. of the total in the first series and 40 per cent. in the second series. These figures may be contrasted with clinical returns for the same period from four maternity units in Glasgow Corporation Hospitals, where 21·6 per cent. of the deaths were assigned to the infections.

(c) Premature babies run a greater risk of contracting fatal infection than do full-term infants. For instance, Table 5 shows that taking those infants who succumbed to infection after having survived the first 48 hours of life, 66 per cent. were classified as premature in the first series and 71 per cent. in the second series. The table also shows that 63 per cent. of the deaths of premature infants surviving the first 48 hours of life were due to infection in the first series and 42 per cent. in the second series.

These inquiries corroborate what is well recognised, that studies of the causes of infant death are subject to considerable error, even under the best circumstances, owing to uncertainties in clinical diagnosis. Spence estimated the error at one-third in his Newcastle series. In the case of the neo-natal period, the error is more than considerable, as in many cases characteristic symptoms of infection are absent or are misleading even to skilled observers, with the result that much infection is undisclosed during life.

The evidence is clear that infection among infants in maternity hospitals, especially in the premature group, may appear and run its course without being recognised either as a cause of sickness or death or as an unwitting source of spread, because of the highly elusive nature of the signs and symptoms. "The occurrence of infection is facilitated by the poor response which the infant's tissues make to invading bacteria of low virulence. This poor response is probably related to the immaturity of the defence mechanism" (Cruickshank, 1945). These considerations furnish the strongest argument for a régime of infant care calculated to secure the greatest possible protection against infection, continuously revised as to its details in the light of experience, so as to make it as simple as possible and yet reliable.

In the hospitals studied, pneumonia and gastro-enteritis together accounted for from 70 to 80 per cent. of the deaths due to infective conditions occurring after the second day. Thrush was not uncommon, though its presence was often missed during life and discovered on post-mortem examination. Septicæmia



and meningitis caused comparatively few deaths, and congenital syphilis was a negligible factor.

The incidence of these infections fluctuates from year to year. When an unusual incidence of infection does occur it is a sign that the standards of technique employed in the nursery should be carefully revised. Gastro-enteritis is sporadic as a rule, but being highly infectious, it may assume epidemic form requiring drastic measures for its control, such as closing the wards to further admissions. The cause and nature of this highly fatal infection of infants are still unknown.

It has been pointed out that the incidence of the severer infections among infants in maternity hospitals varies within wide limits. Much of this difference arises from intrinsic causes, prevention of infection being more difficult in some hospitals than in others. The amount of infection likely to occur in the nurseries is least in those institutions in which the beds are reserved for booked cases without overcrowding, and which serve areas where most of the mothers are well-nourished. On the other hand, conditions least favourable to the prevention of infection are to be found in the larger central hospitals in the cities, which are called upon to treat a relatively high proportion of abnormal and emergency cases and cases of prematurity, and which for the most part serve poor-class districts where many of the mothers are under-nourished and overcrowding is difficult to avoid owing to pressure on accommodation. In these hospitals, as compared with the former, the neo-natal mortality during the first day or two of life is higher, while the risk of infection after that period is enhanced because of the presence of larger numbers of infants with poor resistance and low vitality. The contrast is further reflected in the inability of many of the mothers to breast-feed their infants successfully, a factor which has an important bearing on the prevention of infection. It is under these conditions that the most rigid standards of care should be practised in the nurseries and the greatest attention paid to staffing and planning.

An important practical point is that breast-feeding when well established gives a high degree of protection against infection. The incidence of infection is lowest in those hospitals where breast-feeding is most successful.

The care of premature infants entails a sequence of measures. The first consideration is good obstetrics along with skilled attention from the moment of birth, since mortality is high during the first two days of life. The second consideration is the subsequent protection of these infants from infection, to which they are peculiarly liable and which is apt to be insidious in its onset and course. Prematurity is thus an important predisposing cause of mortality from infection; its prevention raises much more fundamental problems referable to the pre-natal period, mainly of a medico-social kind.

## CHAPTER 6

### BACTERIOLOGY OF THE NEWLY-BORN

The new-born infant is generally immune to certain infections but is highly susceptible or only feebly resistant to others, to which its active immunity is as yet undeveloped. This phenomenon is peculiar to early infancy and makes the problem of neo-natal infection a special branch of bacteriology. Dr G. B. Ludlam contributes the following note on this subject :—

“ Up to the time of rupture of the membranes the fœtus may be regarded as bacteriologically sterile, but occasional cases of infections *via* the maternal blood-stream may occur, as in congenital syphilis or in infection with the virus of rubella.



After the rupture of the membranes the fœtus comes in contact with the vaginal organisms which may multiply in the uterus, particularly in cases of prolonged labour with premature rupture of the membranes. This may lead to neo-natal septicæmia from infection of the placenta or to neo-natal pneumonia from the aspiration of infected fluid to the lungs during respiratory movements due to partial asphyxia.

The initial flora of the infant is derived from the mother's vagina, and from this source gonococcal ophthalmia or thrush may be produced. Such flora is rapidly replaced by organisms derived almost entirely from the skin and respiratory tract of the mother and attendants. Such potential pathogens as the pneumococcus, hæmolytic streptococci and the influenza bacillus appear commonly but in small numbers in the throat in the course of the first few days, but they have difficulty in becoming established and normally do not produce disease. *Staphylococcus aureus* appears early in the nose, but again produces no symptoms in the majority of cases. The bacterial flora of the intestine is variable for the first week. After this, in breast-fed infants, lactobacilli predominate, while in the bottle-fed, coliform bacilli are in excess over the lactobacilli.

The special characters of infection in the infant are mainly due to its immunological state. The infant has no specific active immunity to bacterial invasion and the tissues, including the reticulo-endothelial system which is regarded as mainly responsible for the production of antibodies, react poorly to bacterial stimuli. The new-born infant, however, by transmission of antibodies through the placental circulation, possesses a passive immunity to organisms against which the mother has acquired a humoral immunity. The infant does not, however, possess the same immunity to such organisms as *B. coli*, *Staph. aureus* or *Monilia albicans*, since humoral immunity in the adult does not appear to be developed to them to any extent.

Due to passive immunity in the new-born, diseases such as measles or diphtheria are rare. On the other hand, infections due to such common organisms as *Staph. aureus* and *B. coli* are commoner and may produce severer lesions than at any later period. The feeble immunity response and weak local tissue reaction often result in general infection. Symptoms also may be indefinite and diagnosis of the existence of infection may be difficult.

During the first year of life the original passive immunity gradually wanes, so that this type of resistance is probably insignificant after six to eight months. This is counter-balanced in part by the gradual attainment of an active immunity to the common pathogens and by the gradual maturing of the tissues. The infant may also develop a hypersensitivity to certain organisms which may affect the response of the tissues to their invasion.

Due to the low resistance of the infant, infections in the first month, although usually superficial and trivial, are very common and may lead to more serious complications such as bullous impetigo, cellulitis and various forms of blood-spread infection such as pyæmia, pneumonia or meningitis. It is difficult to determine accurately the incidence of the milder infections since they are frequently undiagnosed or unrecorded. Nevertheless, it may be said that such superficial infections as pustular skin eruptions, paronychia, omphalitis and conjunctivitis are particularly frequent. These are mainly caused by *Staphylococcus aureus*, but conjunctivitis may also be due to such organisms as the gonococcus, the pneumococcus, non-hæmolytic streptococci, *B. coli*, *B. pyocyaneus*, etc. Oral thrush is also very common and relatively harmless, but it may spread to the œsophagus and threaten life, especially in premature or debilitated infants.

The infections that prove fatal in the first few weeks are mainly various forms of pneumonia and blood-borne infection. *B. coli* and *Staphylococcus aureus* are the commonest organisms found, but, in addition, various types of streptococci,



the pneumococcus and the influenza bacillus may be isolated. In broncho-pneumonia, regarded as due normally to extension of infection from the upper respiratory passages, there is usually infection with more than one organism, the commonest being *B. coli*, *B. influenzae* and the pneumococcus.

Neo-natal diarrhoea may also be responsible for a number of deaths when an epidemic occurs. A virus has been implicated in several epidemics, but the aetiology of this condition cannot be regarded as settled. The herpes virus produces aphthous stomatitis in the first year of life, and viruses may also produce a condition characterised by stomatitis and diarrhoea and a small percentage of cases of neo-natal conjunctivitis."

## CHAPTER 7

# THE NURSERY AND THE CARE OF THE INFANT

Nursery provision includes separate arrangements for three groups—healthy infants, sick and premature infants (the special nursery), along with separate isolation provision for infective conditions. The kind of provision and the precise methods adopted in the nurseries will vary according to the size and function of the hospital. We set out, in the following paragraphs, certain principles which we consider to be generally applicable.

**Medical Staff.**—It is now recognised that the care of all the infants should be the special concern of a physician experienced in the care of the new-born but acting in co-operation with the obstetrician. This principle, which is now widely adopted, applies more particularly in the case of the larger and more central maternity hospitals and maternity units of general hospitals, where a pædiatric staff is to be regarded as essential. The pædiatrician should not only have charge of the units for sick and premature infants, but his function should also extend to the care and management of the healthy infants, their nursing and feeding, and to the prevention and control of infection. In all maternity hospitals, rules and regulations for the care of the infant should be drawn up, or at any rate approved by a physician experienced in the care of the new-born and alive to the great risks of infection.

In larger maternity hospitals or units, an important consideration is, in our view, the appointment of a resident medical officer of the grade of pædiatric registrar, responsible to the visiting pædiatrician. This officer would assume the day to day care of all the infants in the hospital, keep adequate records, and prepare an annual report. Opportunities for research would be afforded. It would be an advantage if the registrar so appointed were also attached to the sick children's unit of the general hospital or to the local hospital for sick children.

**Nursing Staff.**—For the due care and safety of the infants in the nurseries (a) the nursing staff should be sufficient in number for the work to be careful and unhurried, (b) there should be a nucleus of permanent trained nurses to ensure continuity of treatment, and (c) a basic nursing technique should be fully understood and practised. As this question of the quality and adequacy of the nursing staff is of first importance for the prevention and control of infection, it is discussed more fully below.

**Records.**—Careful recording of the infants' progress is most important in all maternity hospitals; it is often incomplete or neglected. Medical and nursing details should be entered from day to day on a separate clinical record for the



infant. The importance of being able to correlate these records of the progress of the infant with the ante-natal and obstetric history and progress of the mother will be obvious. A note should be made of all infections affecting the skin, the eyes, the nose, the mouth, etc., however trivial.

We considered whether it would be desirable to prepare and incorporate a standard record form that might be of assistance to maternity hospitals, but as views on method and concept may quite properly differ widely, we decided against it. At the same time, we recognise the importance of good record keeping and the value of reliable statistics for biological studies. It would be most helpful if the Department of Health for Scotland could take the initiative in obtaining agreement on certain national basic data which might be recorded for all infants as a matter of routine procedure on the clinical chart and record form for the first month of life and the manner in which these should be summarised in the form of an annual report.

We consider that the importance of the subject justifies the suggestion that maternity hospitals should make a detailed annual report on the nursery side of their work.

**Instruction in Mothercraft.**—Instruction of the mother in the care of her infant which should have begun during the pre-natal period should be continued while both are in hospital, including breast-feeding and the care of the breasts, along with such matters as bathing and changing. The effectiveness of such instruction will depend on a nursing staff with sufficient time to give to it and a duration of stay of mother and child for at least fourteen days.

As regards breast-feeding, it is necessary, if the best results are to be obtained, that careful attention be given to the breasts both before and after the birth of the child; some mothers require special care in order to avoid difficulties in suckling the infant and possible local complications. Preparation for lactation has been studied in detail by Dr Harold Waller at the British Hospital for Mothers and Babies, Woolwich. The members of the Sub-Committee who visited this hospital were impressed by the methods he had evolved and by the preventive service in operation there, which are described in his book on "Clinical Studies in Lactation" (1939) and his paper—"The Early Failure of Breast Feeding" (1946).

**Co-operation with Health Visitors.**—As a further preparation for leaving the hospital, the future care of the child should be considered in co-operation with the health visitor of the district, who should be notified in advance of the mother's discharge. This co-operation is particularly important in the case of premature babies or delicate infants. It would be highly advantageous if the health visitor who will supervise mother and baby at home could make personal contact with them before their discharge from the hospital and ascertain from the doctor or ward sister any recommendations or advice which should continue to be observed, and what special equipment, if any, should be sent out from the hospital. This procedure would secure continuity of care and assist in maintaining a good working relationship between the hospital, the home and the child welfare clinic, and ensure co-operation with the medical practitioner in attendance.

We attach a good deal of importance to co-operation between the health visitor staff and the midwife of the hospital. Apart from the specific exchange of information about individual cases, it would be useful to encourage periodic staff meetings between the health visitors and the senior midwife staff of the maternity hospital. These meetings would be mutually helpful and would keep the field workers abreast of advances in the principles of infant care and nursing technique.



**Nursery Accommodation for Healthy Infants.**—Views and practice differ as to what is best for mother and child. Some act on the principle of the ward for the mother and the nursery for the infant; some consider that the infant should be taken to a nursery at night only; others, again, believe that the infant should be kept in a cot beside the mother unless it requires special care, is premature, or sick or noisy or for reasons connected with the mother's health. Opinions differ strongly as to the best method. While we make no specific recommendation, certain of the Sub-Committee favour a separate nursery for healthy infants. (One of our members has recently visited hospitals in Sweden and finds that medical opinion there is emphatic in support of this provision.)

In any case, an adequate nursery suite is necessary, and good lighting and ventilation are essential. The large nursery of twenty to thirty cots should be avoided in favour of a suite of smaller nursery units or wards preferably holding from four to six cots, and allowing at least forty square feet of floor space per cot. Too often in nurseries where a generous allowance of floor space per cot has been provided, the infant cots are placed side by side along a wall, leaving a large empty area in the middle of the nursery. Cots should be so arranged that the allotted space is properly utilised. All new provision should conform to this standard and an effort made to subdivide existing large nurseries, if at all possible, and to avoid the common bath. Where a suite of smaller nursery wards is provided, as suggested, each ward should contain its own arrangements for bathing and changing. In addition, each infant should have its own portable bath, and locker (attached to its cot) containing cottonwool, towel, soap, etc.

**The Special Nursery.**—Maternity hospitals should be equipped and staffed to deal with their own sick and premature infants. The amount of this accommodation will depend on the type of case admitted to the hospital and the extent to which infants requiring special care are admitted after delivery at home or elsewhere. Since the type of accommodation is essentially the same for both sick and premature infants, the special nursery should consist of small wards containing not more than four cots each, along with cubicles to contain one or two cots. The wards and cubicles should have wash-basins, and oxygen should be available. They should be well ventilated and have good heating arrangements. A small room should be provided as a treatment room. There should also be provision for nursing mothers, a milk kitchen and laundry facilities.

It may be estimated that the special nursery for these purposes in the average maternity hospital should contain 20 cots per 100 maternity beds. This figure is based on the following considerations:—

*Sick Infants.*—Provision for sick infants should be in the neighbourhood of 10 cots per 100 maternity beds. This proportion will be sufficient to provide for the nursing of infants who may require special attention.

*Premature Infants.*—It is necessary to provide specially for the care of premature infants born in the hospital and, in addition, for premature and weakly infants born in the district, where immediate hospital treatment is in the best interests of the infant. The incidence of premature birth in the population generally is not known with sufficient accuracy to enable a definite calculation to be made of the amount of accommodation likely to be required. The premature birth rate in the Scottish hospitals shown in Table 1 varied from 3 per cent. to 12 per cent., the latter figure applying to certain special teaching hospitals admitting a high proportion of abnormal maternity cases. In the four municipal hospitals of a large industrial area (Glasgow), which admit a relatively high proportion of normal cases, the rate for live premature births was 7 per cent. This figure may be accepted as representing a fair cross-section of an industrial population. It would appear that, for the average maternity hospital, allowing for the admission of some infants from outside and for a reasonable period of



indoor care, a ratio of 10 cots per 100 maternity beds would be adequate. It may, however, be regarded as a better policy in urban areas served by several hospitals to concentrate provision for the treatment of premature infants from the area in one or two selected hospitals, with special premature units, in which case corresponding adjustments of cot ratios would fall to be made.

For premature infants, certain ranges of temperature are necessary. As a rule, very small babies need a cot temperature of  $90^{\circ}$ – $95^{\circ}$  F. In this country, room temperatures of from  $75^{\circ}$ – $80^{\circ}$  are favoured, varying to  $60^{\circ}$ – $70^{\circ}$  F. for “cooling off.” A relative humidity of 70 per cent. should be maintained.

In the hospitals visited it was found that the kind and size of the wards for premature infants varied considerably, most reliance being placed on nursing care and observance of a carefully-enjoined technique, the greatest care being taken to maintain the cot temperature at  $90^{\circ}$  F. by jacketed hot-water bottles or other means, and the nursery units being well ventilated. At Sorrento Maternity Hospital, Birmingham, under Dr Mary Crosse, the ward unit for small premature babies holds four cots, this being regarded as a convenient size and number for nursing purposes; the rest of the accommodation was in single cubicles. Infants are admitted from all parts of the city. Nursing attention is cot-side, and the nurse who changes or otherwise attends to the infant does not prepare or give the feeds. The wearing of gowns and masks and washing the hands before handling the infant are insisted upon. The members of the Sub-Committee who visited the Sorrento Maternity Hospital were impressed by the arrangements of the premature unit and by the technique evolved by Dr Crosse. We commend Dr Crosse’s book on “The Premature Baby” (1945), where full details are given.

Apart from the obstetric care which premature labour entails, methods of resuscitation should be immediately available, and, above all, a prepared and heated cot ready for the infant in order to avoid the serious risk due to loss of heat. The care of the infant at this stage should be entrusted to a specially-trained nurse, and the infant removed to the special nursery as speedily as possible. Premature infants require minute care during the first 48 hours of life. The premature baby is more liable to contract infection than the normal infant. For this reason, infants in the premature nursery unit must be safeguarded against the introduction of infection and the risk of cross-infection by carefully thought-out standards of care and attention.

Where premature infants are admitted from home, they should be transported in a special ambulance or car, equipped with a supply of oxygen and a heated carrier for the infant, along with a nurse in attendance.

**Isolation Accommodation.**—In addition to the special nursery, cots should be available for the isolation and separate nursing of intercurrent infections arising among the infants in the hospital, unless or until it is decided to remove them elsewhere. Provision should take the form of single cot cubicles (*i.e.*, cells) in the ratio of 5 to 10 per 100 maternity beds, according to the function of the hospital and its locality.

**The Milk Kitchen.**—Facilities for the preparation of infant feeds, the storage, cooling and handling of milk, the cleaning and sterilising of the feeding-bottles, and the methods employed in making up and administering the feeds, should be such as to eliminate the possibility of milk acting as a vehicle of infection. Raw milk should not be given to infants. The position, size and equipment of the milk kitchen are matters of great importance. As regards the position of the milk kitchen, the balance of advantage would appear to be in favour of the central kitchen in charge of a trained nurse with no other duties, in preference to the ward kitchen under the ward staff. This recommendation should be considered in the design of new maternity hospitals.



**Administration of Bottle-Feeds.**—The following paragraph is quoted from the Medical Research Council Memorandum No. 11 on “The Control of Cross Infection in Hospitals” (1944):—“Careful precautions are necessary in the preparation and giving of bottle-feeds. It is strongly recommended that nurses who change infants’ napkins (or otherwise deal with excreta or with septic conditions) should not prepare or give infant feeds. In whatever way duties are arranged, however, it is of the utmost importance that every nurse should wash her hands thoroughly (a) before preparing a feed; (b) after changing an infant; (c) before giving a feed. Furthermore, she should wear a face-mask throughout.”

**Control of Infection.**—The Memorandum on “The Control of Cross Infection in Hospitals” quoted above explains the risks of infection that may occur in the nursing of infants, and contains a full code of detailed recommendations on how to avoid these risks. Paragraph 9 deals specifically with the hygiene of infants, and discusses such matters as hand-washing, laundry, breast-feeding, preparation of bottle-feeds, milk kitchens and their equipment, temperature taking, etc. The arrangements for safe and speedy disposal of soiled napkins is a matter of vital importance. No slunging should be done in the nursery unit. Other preventive measures are set out in other sections of the Memorandum. This publication is strongly recommended as a working basis and as a guide for the instruction of nurses.

**Staffing of the Nurseries.**—Infant care involves the due exercise of a well-devised nursery routine. In no department of nursing is it more necessary for the nurse to have a complete understanding of the reasons why she is expected to follow an orderly aseptic régime in all she does, and to be observant of the least sign of anything abnormal in the progress of the infant. This depends on good teaching and, above all, on practical instruction and explanation at the bedside.

*The Pupil Midwife.*—It is customary for maternity hospitals which are also training schools for nurses to staff the nurseries wholly or mainly with pupil midwives under training for the C.M.B. Certificate. The recruits are mostly general trained nurses, but the course of training in midwifery is intensive, as it should be, and the time that the nurse can spend on the nursery side of her duties is somewhat scanty, and may be as short as from four to six weeks during Part I training and the same during Part II training. These frequent changes of staff are not in the best interests of the infants, because continuity of treatment is too often broken unless it is balanced by an adequate nucleus of trained nurses. Further, it is doubtful whether the trainee appreciates the full importance of training in the management and nursing of infants. In the curriculum, the emphasis is on obstetrics, while it is felt that the examination for the C.M.B. Certificate does not lay sufficient stress on the practical nursing side of infant care, which tends to assume a minor place in the nurse’s thoughts. Pupil midwives should be led to think that all their work in hospital is equally important.

*Standards of Staffing.*—In order to achieve the best results, there should be a basic permanent staff, sufficient to secure continued skilled attention for the infants and to train the pupil midwives as fully as the curriculum permits. What the total staff should be in point of number and quality will vary with the size and function of the hospital, but the following recommendations and experiences may assist consideration of the problem.

As regards the premature unit, nursing standards have been suggested by the Advisory Committee to the Ministry of Health on the Welfare of Mothers and Young Children. The Ministry of Health Circular 20/44 on the Care of the Premature Infant (1944) says: “There is need for a highly-skilled nursing staff on a numerical basis of 1 nurse to 1½ infants. In a premature infant unit of, say, 20 cots, 6 of the nurses should be permanent staff who should be State-registered



general or children's nurses, and have had special training with premature infants. The remainder of the nursing staff should consist of nurses training in children's diseases, pupil midwives, and nurses undergoing general training." The United States Department of Labor recommended in its publication referred to in the footnote below a ratio for full-term infants of 3 nurses to 8 cots and 3 nurses to 4 cots for premature babies.

The Report of the Sub-Committee on Neo-natal Mortality to the British Pædiatric Association (1946) refers to the staffing of nurseries. It says that "there must be a sufficient number of day and night nurses properly trained in the care of newly-born infants and able to impart their knowledge to trainees," and, as regards premature infants, "the staff must be adequate in number, the seniors being specially trained in the care of prematures and not engaged upon other duties."

*Auxiliary Staff.*—Apart from the question of the precise proportion of hospital trained staff that should be employed, there is another method of partial staffing with nursery nurses which has been tried out with very promising results in Aberdeen Maternity Hospital and elsewhere, as in Sorrento Maternity Hospital, Birmingham. In Aberdeen the Special Nursery with 33 cots for premature and sick babies and those requiring special attention is in charge of a sister with three hospital trained staff nurses, ten nursery nurses, and four pupil midwives; all domestic work is left to the domestic daily worker. The nursery nurses\* are on the permanent staff and are selected as pupils for a trial period of one month. They rapidly acquire an interest in the work and, being permanent, are of greater service in dealing with premature and sick infants than are the pupil midwives, whose spell of duty is necessarily limited to some four to six weeks at a time, not long enough for them to acquire an intimate practical knowledge of the routine duties involved. Mrs Thomas, previously Sister-in-charge of the nursery, has contributed to the Sub-Committee a full account of the nursing arrangements and system adopted. As this experience may be useful, the main points in her evidence are included as an appendix to this Report (Appendix 2). We strongly recommend this method of supplementing the nursing staff for infants in maternity hospitals. Dr Harold Waller commented favourably on the nursery nurse or ward orderly at the British Hospital for Mothers and Babies, Woolwich, during the visit of members of the Sub-Committee, remarking that they enabled the sister-in-charge to do her proper remedial and educative work.

*Suggestions for Staffing.*—It is not advisable to recommend definite standards for all maternity hospitals for the reason that requirements will differ according to the size and function of the hospital, the proportion of emergency cases admitted, the premature birth rate and the social circumstances of the district served. Hospitals which are training schools for midwives, and especially those which teach medical students, will require special consideration. The following suggestions refer particularly to the last-mentioned groups.

The care of healthy infants should be the responsibility of the sister-in-charge of the maternity unit, but she should have the assistance of two experienced staff nurses, so that a senior member of the staff is always on duty to supervise and train the pupil midwives of the unit. The numerical standard commonly recommended for maternity hospitals, namely, one nurse to one maternity bed, should be sufficient to cover the attention required by mother and infant under normal circumstances and for the training of the pupil midwives in infant care generally.

Where a premature unit is established, as is recommended for the more centrally-situated maternity hospitals in industrial areas, the aim should be to reach the minimum standard of 1 nurse to  $1\frac{1}{2}$  cots, with an experienced sister-in-

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\* Referred to as "auxiliary workers" in "Standards and Recommendations for Hospital Care of Newborn Infants"—U.S. Department of Labor, Children's Bureau, 1943.



charge. This staff should include a fixed nucleus, amounting to one-third, of general and sick children or general and fever-trained staff nurses. The remainder of the staff should consist of nurses training in children's diseases, nursery nurses (if it is decided to employ such nurses) and pupil midwives. For smaller units, the sick and premature infants could be under the charge of the same sister.

The unit for sick infants and those requiring special attention is usually administered along with the premature unit, the nursing staff being common to both, except in the case of the cots for the isolation of infections, where a separate staff is necessary. The ratio of nurses to cots should be similar to that recommended above for the premature unit, namely, 1 nurse to  $1\frac{1}{2}$  cots. The personnel of the sick nursery should allow of a senior nurse being always in charge.

We think it appropriate to suggest that part of the training of a Sick Children's Nurse might be obtained in the nursery of a maternity hospital, say, for a period of three months. The General Nursing Council might be asked to give consideration to this suggestion when the curricula for the training of nurses are being revised.

**Training of Pupil Midwives.**—For the training of midwives much ground has to be covered, involving frequent changes from one duty to another, while time has to be found for theoretical and practical instruction during Part I and Part II of the curriculum. The exigencies of training are such that lack of continuity of personnel in the nurseries cannot be avoided. At the same time, practical training in the care of the infant and in the prevention of infection (barrier nursing) should be as sound as possible and should be a feature of the examinations for certificates or diplomas in midwifery. There also arises the question of introducing into the curriculum some teaching in elementary bacteriology and the principles of hygiene as applied to midwifery and to infant infections. In this connection, Memorandum No. 11 of the Medical Research Council on "The Control of Cross Infection in Hospitals" would make an excellent practical guide for the instruction of nurses. Professor R. W. Johnstone, Chairman of the Central Midwives Board for Scotland, in his evidence expressed himself as in general agreement with these views. It is accordingly recommended that the Board be asked to review the arrangements in maternity hospitals for the training and examination of pupil midwives in the care of infants.

(Signed)

A. S. M. MACGREGOR ( <i>Chairman</i> ).	
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## APPENDIX 1

### The Importance of Prematurity as a Predisposing Factor in Neo-natal Infection

Investigations carried out in the three largest cities of Scotland show that some two-thirds of all the neo-natal deaths from infection occur among premature infants, despite the fact that the prematurity rate even in hospital is not more than about 12 per cent. of the total live births. It is obvious, therefore, that prevention of prematurity would greatly reduce the number of deaths due to infection.

**Incidence of Prematurity.**—The general incidence of prematurity cannot be accurately estimated because of the difficulty of weighing in domiciliary practice. The broad figure of 4.3 per cent. of the total births has been estimated for New York State in 1936 (Yerushalmy, 1938) and 7 per cent. for New York City in 1939 (Duffield *et al*, 1940); an incidence of 6.5 per cent. is given by Bundesen for Chicago in 1939. In Birmingham in 1943 the estimated figure was 6.3 per cent. (Crosse, 1945). Hospital figures, while they



give accurate information about premature infants not available as regards domiciliary births, do not represent a typical cross-section of the community. The prematurity rate of 5.6 per cent. for Chicago Lying-in Hospital (Potter and Adair, 1938) seems fairly representative of American hospitals. In Britain, hospital figures are usually higher. Queen Charlotte's Hospital had an incidence of 8.1 per cent.; in booked cases it was 6.8 per cent. and 27.2 per cent. in emergency cases (Sandifer, 1944). The incidence of prematurity in hospitals will depend on the proportion of emergency cases admitted for treatment. For instance, in the Aberdeen Maternity Hospital (Baird, 1945), the general incidence was 13.4 per cent. in 1941-42 but in booked cases the rate was 8.8 per cent. and in emergency cases it was 39.4 per cent. In certain Scottish maternity hospitals\* the prematurity rate for the years 1940-43 varied from 2.8 per cent. in the war emergency units to 12.7 per cent. in the hospitals situated in the large industrial areas, where a relatively high proportion of emergency cases are treated. In the hospitals in England visited by members of the Sub-Committee, the premature birth rate varied from 4.7 to 10 per cent.

**Death Rate from Prematurity.**—This rate should be considered along with those for the other inter-related causes of death that affect life in its pre-natal and post-natal stages. The following figures are quoted to show the national trend in recent years of the mortality rates for prematurity and congenital debility and of the still-birth rate. It would appear that the downward movement of these rates, taken together, has been accelerated during the war years.

The mortality rate per thousand live births in Scotland attributed to prematurity has fallen comparatively slowly in recent years. The rate was 13.75 in 1945, and 18.76 in 1934, although it has varied within these limits in the intervening years. On the other hand, the mortality rate attributed to the vague designation "congenital debility" has fallen rapidly and consistently. In the five year period 1921-25 it was 14.2, a little less than the rate for prematurity; in the period 1931-35 it was 9.0, declining to 5.08 in 1943 and 3.75 in 1945. Again, the still-birth rate has declined from 42 in 1939, the year when still-births became registrable in Scotland, to 36 in 1943 and 33 in 1945. These rates are consistently lower in counties than in the large burghs.

In England and Wales a corresponding fall has occurred in the mortality attributed to prematurity, the rate per 1,000 related live births being 11.01 in 1945 compared with a rate of 17.03 in 1934. The mortality rate from "congenital debility" has fallen rapidly, though not from such a high figure as that quoted for Scotland. Thus, in 1921, this rate in England and Wales was 7.36, in 1931 it was 3.32 and in 1941 it was 2.14 falling to 1.63 in 1942. Still-births have been registrable in England and Wales since 1927; the rate per thousand total births was very constant at 40 to 41 up to 1936, after which it fell steadily to reach a figure of 35 in 1941 and 28 in 1945.

Certain figures given by Abramson (1941) for New York may be quoted. The component part of the neo-natal mortality rate due to prematurity fell from 14 to 11.6 per thousand births between 1930 and 1939; the decline was most evident (63 per cent.) in the 7 to 29 day period; less improvement (27 per cent.) occurred in the 2 to 7 day period, but none in the deaths occurring during the first day. The decided fall in the deaths from the seventh day onwards is attributed to the prevention of infection.

**Causes of Prematurity.**—Analysis of cases of prematurity shows that in many the cause is difficult to ascertain. For example, Baird (1945) has shown that, in a series of 738 premature labours, under his direct care, the reason for the onset of labour was unknown in 52 per cent. or over half of the series. In the other 48 per cent. the prematurity was associated with a recognised obstetrical cause, the most important being toxæmia and twin pregnancy, as shown in Table A. It was also shown that premature labour was twice as frequent among booked hospital cases corresponding to the Registrar-General's Social Classes III, IV and V as amongst private patients belonging to Classes I and II. Again, where premature birth occurred among the latter classes, the cause was seldom unexplained but was due to a recognised obstetrical condition. It was found also that when premature infants of the same birth weight were compared, the hospital group had a mortality rate twice that of the private practice group. Again Table B from the Returns of the Registrar-General (England and Wales) shows that the death rate from prematurity is twice as high in Social Class V as in Social Class I. Baird concludes that this contrast is largely accounted for by differences in the state of nutrition among the expectant mothers composing the two classes, and that where the general health of the mothers is good both the premature birth rate and the mortality rate of prematurely-born infants are relatively good. These conclusions are supported by the studies of Cameron and Graham (1944) in Glasgow on the diets of pregnant women in relation to the incidence of premature birth and of still-birth.

**Prevention.**—The prevention of prematurity is closely related to the prevention of still-birth and of "congenital debility." While the mortality rate from prematurity and the still-birth rate have undergone decided reductions in recent years, the rate for "congenital

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\* See Table 1—page 14.



debility" has declined even more steadily and rapidly. The behaviour of these three inter-related "causes" of death implies a progressive saving of infant life in its pre-natal and post-natal stages. This trend, which has been evident for some years past, has continued during the difficult war years. Though little is still known about the specific causes of these early deaths and of premature births, apart from obstetrical reasons, it is clear that some factor or factors have been operating to increase the survival rate. The whole problem is one that is much in need of further investigation.

It may, however, be confidently inferred that the improvement in the vital statistics of early infant life is, in the main, attributable to three broad factors—(a) ante-natal and obstetric care; (b) the much greater health consciousness exhibited by expectant mothers which has been intensified during the war years; and (c) the better feeding of the poorer classes of the community which has also been a feature of the war years, particularly in the towns. Though it may be too soon to assess accurately the degree of this last influence from the standpoint of vital statistics experiences from all parts of the country point to the conclusion that war-time nutritional policy has had a beneficial effect on the general health of women of child-bearing age.

Baird (1945) has carried out special investigations in Aberdeen bearing upon the influence of good nutrition and environment on prematurity, still-births and neo-natal mortality. His results support the view that, apart from the specific care which the pregnant woman requires, much depends on a continued nutritional policy for the country. The question of attaining minimal rates must, however, be viewed against the background of the general health of women of child-bearing age, which is again dependent on measures designed to ensure that all mothers will have had the advantage of good food and environment from infancy.

TABLE A  
*Aberdeen Maternity Hospital :  
Causes of Prematurity in 738 Cases out of 8,808 Booked Hospital Cases (7 years' data)*

Cause of Onset of Premature Labour	Number	Per Cent. of Total Premature Labours
Cause unexplained ... ..	383	51·9
Accid. Hæmorrhage (without Toxæmia) ...	29	3·9
Eclamptic Toxæmia ... ..	119	16·1
Twin Pregnancy (including 15 cases of Toxæmia)	90	12·2
Gross Fœtal Deformity ... ..	25	3·4
Placenta Prævia ... ..	20	2·7
Syphilis ... ..	19	2·6
Severe maternal heart disease ... ..	19	2·6
Miscellaneous ... ..	34	4·6
	738	(8·38 per cent. of the total deliveries)
Total number of premature babies ... ..	798	(8·97 per cent. of the total babies born)

TABLE B  
*Deaths under One Year per 1,000 Live Births from certain causes by  
Social Class,\* England and Wales, 1939*

Social Class	Deaths under One Year per 1,000 Live Births from		
	Premature Birth	Congenital Malformation	Injury at Birth
I ... ..	8·7	4·5	2·6
II ... ..	11·5	5·1	2·9
III ... ..	13·4	5·8	2·4
IV ... ..	14·7	5·8	2·6
V ... ..	16·4	6·3	2·7

\* The five classes distinguished by the Registrar-General includes Class I, higher ranks of business and professional life; Class II, retail trades, clerks, teachers, etc., farmers; Class III, skilled labour; Class IV, neither artisan nor wholly unskilled farm labourers; Class V, unskilled labour.



## APPENDIX 2

### Aberdeen Maternity Hospital—Sick Nursery Nursing Technique

The nursery caters for 33 babies and is divided into four departments, (1) a Nursery for premature babies, (2) a Cooling Room for premature babies, (3) an Isolation Room for babies with spots or sticky eyes, or for babies admitted from outside, (4) a Feed Kitchen, in which all feeds for the nursery and the hospital are made up.

(1) The Premature Room has an average of 12 babies. It is divided into four cubicles, with, on day duty, one nurse to every cubicle, *i.e.*, one nurse to every three babies; on night duty there are two nurses and a staff nurse. The Premature Room admits all difficult deliveries, such as prolonged labour, breech and forceps deliveries, besides all premature babies or babies under  $5\frac{1}{2}$  lbs.

Premature babies from the District and City of Aberdeen, Kincardineshire and Banff, are also admitted. These babies are collected in special baskets (carrier pigeon baskets) either by ambulance, W.V.S. car, or private car. If the baby is very small, a nurse with C.O.2 and oxygen cylinder is sent out. The longest journey undertaken was to collect a 2 lbs. 12 oz. baby from a crofter's cottage 70 miles away.

During the past year, nearly 600 babies have passed through the nursery, and of this number, about one-third were premature babies.

(2) In the Cooling Room there are three nurses who work on a shift system, the first nurse doing duty from 5 a.m.—12-30 p.m., the second from 8 a.m.—5-30 p.m., and the third from 2 p.m.—10 p.m. The babies in this room do not have night feeds, and so a minimum of supervision is required. They are trained as far as possible to a normal home routine. Lights are put out at night, and no baby is disturbed until 5 a.m.

(3) The Isolation Room has 5 to 6 cots, but this is a fluid number and may vary considerably. Into this room are admitted any babies with sticky eyes or spots, or suspiciously high temperature, babies from nursing homes and smaller county hospitals, or babies sent in for adjustment of feeding. They are admitted up to three months of age. There are three nurses in this room, only one on duty at a time. The nurses do an eight hour day and relieve each other for days off and nights off. The Isolation Room has its own bathroom. While on duty in the Isolation Room the nurses do not touch any baby in any other room. Before being transferred from the Isolation Room to the Cooling Room, or back to the ward nurseries, babies are bathed and a complete clean set of clothing is put on and the baby is put into a clean cot.

(4) In the Feed Kitchen at the present time there is one pupil midwife, with the sister-in-charge supervising. The pupil midwife is one week in the Kitchen, and while there does not touch a baby in any department. She is on duty from 8 a.m. to 5 p.m. every day and is entirely responsible for the preparation of all artificial feeds in the nursery and the hospital. All feeds are made up for 24 hours; all sugar is put into solution and boiled before use.

**Staff.**—The nurses on the basic staff of the nursery are not mobile, *i.e.*, they do not move from one department of the hospital to another. Besides the sister, there are three staff nurses and ten nursery nurses. The staff nurses all have two certificates at least, either State Registered General or State Registered Sick Children's Certificate and the C.M.B. Certificate. They do an eight hour day and relieve each other for days off and nights off. The nursery is never left without a senior nurse on duty. There are four pupil midwives in the nursery at one time and they do 3 to 4 week spells. This is not considered to be long enough, but it is all that can be allowed until such time as the Schedule of the Part 1 pupils is changed to a more practical one. During the time the pupil midwives are in the nursery they concentrate on the care of premature babies and the feeds.

**Nursery Nurses.**—The previous experience of these nursery nurses is very varied. The majority have had a training of one year at a Home Nursery in Aberdeen, which deals with babies from unsatisfactory homes in the city. The girls are very suitable for routine work. Some have the Child Care Reserve Certificate obtained during the war, but none is completely inexperienced. Their ages range from 17 to 45; the nurse aged 45 is very good and is a very good influence in the nursery.

The pupil nursery nurses are all picked girls and come to the Aberdeen Maternity Hospital Sick Nursery for a trial period of one month, during which time they are attached to another nurse and are not allowed to do anything on their own. They do not receive any recognised training other than the one month's trial and are taught the principles of



barrier nursing. If at the end of the month's trial a girl is not selected, the reason for her unsuitability is generally that she is not interested in very small babies, rather than inability to understand the technique. If she is not interested she is no use in the nursery. It is explained to the nursery nurses how vital is their part in the whole scheme, and although they may not fully understand the technique of barrier nursing, they appreciate that a great deal depends on them.

The nursery nurses' salaries vary from £52 to £70 per annum, according to qualification. The hospital provides accommodation for most of the staff, although some live out by choice. None of the staff nurses lives out at present, but it would be more satisfactory for staff nurses, rather than young nursery nurses, to live out. The living-out allowance is £65-£100 per annum.

The staff nurses' duties are mainly supervisory as the nursery nurses, being untrained, need a great deal of supervision. The view of the sister-in-charge is that the nursery nurses, because they are permanent staff and have been in the nursery for some months, are of more use than pupil midwives. Some are very capable. They have a better knowledge of the running of the nursery and are more interested. The pupil midwives are too short a time in the nursery to be really useful, and they are not very interested in the care and feeding of young babies, because babies take a very secondary place in the C.M.B. Examination. If a pupil midwife had to bath and feed a baby for her Part 1 Examination, the interest in the babies would markedly increase. More use could perhaps be made of pupil midwives, but a basic staff is essential.

**Hours and Duties.**—All day nurses come on duty at 8 a.m.; for days off and nights off there is a relief nursery nurse. Night nurses are on duty from 10 p.m. to 8 a.m. Off duty times are arranged to suit the peak periods of bathing, changing and feeding. No oiling or bathing is ever done during the night. The cleaning of the nursery, bathings and oilings, are always done during the day.

**Uniform.**—Each nurse in the nursery wears a white coat and a muslin head square as uniform. No hair is allowed to show. Coats are changed every other day, and head squares every day. Nurses who live out have lockers in one of the cloakrooms in the hospital where they change into their white coats and indoor shoes. Any nurse coming to work in the nursery from another department in the hospital must take a bath and change her uniform completely before coming on duty in the nursery. Masks are kept at the door of the nursery, and as a nurse enters she takes one and puts it on.

**Routine in the Nursery.**—At 8 a.m. the nurse's first duty is to clean the lockers. The locker is a metal container 9 ins. by 18 ins. by 24 ins. deep, with one shelf in the middle. It is hooked on to the bottom of the cot; the door opens downwards and forms a tray. Each locker costs 19s. 6d. In the locker are kept all the bowls and equipment necessary for that particular baby. The lockers are washed out with 1 per cent. carbolic, the little bottles of methylated spirit and gentian violet are wiped over with carbolic, all enamel ware is boiled, and any cotton wool swabs are sent for re-sterilizing. After boiling, the equipment is collected and put back into the lockers, and fresh cotton wool swabs are put out. Every baby has its own methylated spirit and gentian violet bottles, thermometer, flask of oil, soap and dish, packet of cord dressings with needle and cotton, and eye swabs separate from other wool swabs. In the bottom shelf of the locker is the gown which the nurse puts on before she touches the baby.

The cots are made of metal and covered with white drill covers, which are changed once a week. The mattresses are made of chaff and are sterilized after every baby. Blankets are changed as required and washed at the laundry. The nurses do not do any cleaning in the nursery, other than cleaning of equipment and hand-basins. All cleaning is done by the domestic worker, who sweeps, dusts and cleans all departments and also deals with all dirty linen, both sorting and counting. She washes and irons all mittens and booties. She wears a white apron and mask when cleaning in the premature room, as she is in close contact with the cots. No dusting of walls, or high dusting, is done while babies are in the nursery. Once a month the babies are all removed to another room, and the walls are brushed, the blinds shaken and windows and paintwork washed.

**Feeding of Babies.**—The nurse in the Feed Kitchen puts the feeds in a basket on a table outside the kitchen door. The bottles are marked by means of key rings. At feed times, the nurses take the feeds from this table. No napkin bin must be in the nursery while feeding is in progress, and no baby is changed while feeds are in the nursery. This ruling is very strictly adhered to. If dirty, the baby is not changed until the feeds are finished. In each locker, the baby has its own mug for heating its feed. The mug which is boiled every morning, is put out on the flat top of the locker and filled with hot water. This method is regarded as preferable to communal heating of feeds. In each locker the baby has its own teat in a gallipot. Gallipots and teats are boiled once a day. After the feed is given the teat is washed under running water and put back in the gallipot. The



nurse washes her hands and puts the teat on the baby's feed before putting on her gown. Each nurse has three, or sometimes more babies to feed. All nurses, including the nursery nurses, are taught to tube-feed. The tubes are wrapped separately in a little bag and boiled, then dished up in catheter dishes with lids, one tube to one dish.

Each baby is given its own teat, and nurses are put on their honour to see that this is carried out. Each baby has a gown of its own which the nurse, or anyone attending the baby, puts on, before handling it. The gowns are kept in the locker. They are changed every other day or oftener if soiled. Hands are washed with plain soap and running water and no nail brushes are used. An adequate supply of hand-towels is available.

**Changing of Babies.**—The bin in which dirty napkins are put is lined with a washable bag and has a lid. When the bin is full, the bag is lifted out and a clean one put in. When a nurse is changing a baby she does not wear a mackintosh apron in addition to the gown kept for that particular baby, as mackintosh aprons are not approved of. The same gown is worn for feeding and changing. All premature babies are changed in their cots and other babies on the nurse's knee. Table changing is not advised as, unless large numbers of individual sheets are provided, a baby is changed on the same sheet as every other baby.

**Bathing.**—For babies in the Cooling Room, there is a communal bathroom with six baths, and as there are twelve babies, this is roughly two babies to each bath. The nurse puts on the gown before she carries the baby to the bathroom. There are no lockers in the Cooling Room. The bath towels are hung on heated rails in the bathroom, with each baby's name on its towel. The baths are cleaned once a day and all enamel-ware (soap dishes, trays, pots, etc.) is boiled once a day.

Premature babies are oiled every other day to avoid too much handling. If they are new they are oiled in their cots. Each baby has two oiling blankets—small pieces of flannel or blanket; these are clean for each oiling. If the baby's condition allows, it is oiled on the nurse's knee. The Birmingham Maternity Hospital contend that oil is not sterile when only put through an ordinary autoclave, as is done in the nursery, but experience has shown that the babies seldom have spots.

Electric cradles are used to give extra heat for premature babies, ordinary wall thermometers being used inside the cradles to ascertain the temperature. One light bulb is usually sufficient to maintain a temperature of 85 degrees Fahrenheit. The covers for the cradles are made of gamgee covered with butter muslin. Hot bottles are used if necessary, and those are put under the chaff mattress. There is no control of moist air, but outside the nursery door there is a sterilizer in regular use and this keeps the air fairly moist.

Bigger babies admitted to the nursery, *e.g.*, forceps and breech babies, are treated in the same way as premature babies. They come up from the labour ward wrapped in a delivery towel and are put into a warmed cot. They remain untouched for twelve hours or longer if their condition is not good. Their first cleansing is an oiling done in the cot. No breech or forceps delivery baby is lifted out of its cot for three days.

**Clothing.**—Experience has shown that clothing made of lint and boiled helps to keep down spots and that the wearing ability of lint is extremely good. The first articles made in March 1942 were still in use a year later. It is not considered necessary for the babies to wear woollen garments while in a temperature of 85 degrees. Some babies, if they are very feeble, wear no clothing at all, but live under the cradles in a naked state. The usual clothing for the babies is a lint skirt and a viyella gown, a napkin, mittens and booties, and little lint petticoat bag which ties round the middle and so avoids disturbing the baby when being changed.

**Equipment.**—The following methods have been devised to make the technique as careful and fool-proof as possible. Communal bags or drums of sterile dressings are not used. A large number of lint bags approximately 6 inches square and clearly labelled to indicate the purpose for which the contents have to be used, are provided in the nursery, *e.g.*, cord dressing bag containing cord dressings and needle and cotton; mouth bag containing pieces of old linen cut to a size suitable for cleaning dirty mouths; eye bag containing small pieces of cotton wool for bathing eyes; bag of dressings containing one piece of wool 3 inches square, two pieces of gauze, six wool swabs, and a piece of bandage, etc. Each baby has its own set of bags. It is most important that there should be adequate equipment as it provides the means for good work.

**Feeders.**—Small cotton squares are used and there must be an adequate supply. There are 200 in the nursery. They are discarded at once when soiled, as soiled feeders attract flies.

**Mittens.**—All babies always wear mittens. These are changed every day and are always boiled.



**Napkins.**—Ordinary turkish napkins are used. They are kept in place with a safety pin. Nurses, when doing the changing, collect napkins from the clean linen cupboard and lay one on each locker. Napkins are not taken from a communal pile during changing. The soiled napkin is put into the baby's pot and later tipped into the napkin bin which stands in the corridor. Forceps are used to put the napkin into the bin if necessary. Soiled napkins are never touched by the nurses or the domestic worker, and are not counted before going to the laundry.

**Feeds.**—The feeds are all made up on a 24 hour basis by the nurse on duty in the Feed Kitchen. When the Feed Kitchen nurse is off duty, a staff nurse deals with feeds if necessary. Milk is boiled, whether cow's milk or breast milk. Breast milk can be either pooled or the mothers' own. After bottling, feeds are put into the refrigerator in which the temperature does not go below 43 degrees Fahrenheit. The bottles are ordinary medicine bottles and are not capped. Feeds are not autoclaved after bottling, as this is not thought to be necessary. Cleanliness is most important in the Feed Kitchen, and comes before accuracy. Nurses are taught to wash their hands frequently during the making up of feeds. Special squares of butter muslin marked "Feed Cloth," are used to cover feeds and these squares are never used for any other purpose. Very strict discipline is maintained in the Feed Kitchen.

**Weighing Scales.**—A fresh weighing square is used for every baby weighed. These squares are made of lint and weigh  $1\frac{1}{2}$  ounces. No nurse is allowed to adjust the balance of the scales.

**Construction.**—The nursery building is an improvised one and was formerly an isolation block for mothers. The partitions between the cubicles do not go up to the ceiling. Each cubicle is 11 feet square and takes three or four premature babies. The nursery is ventilated by windows which are opened from the bottom, but have a board inserted so that air is admitted from between the sashes.

**Visitors.**—Visitors are not allowed into the Premature Room. If a baby is in the Cooling Room he is brought in his cot to the door of the room.

**Health of Nurses.**—Nurses must report at once to matron if suffering from a cold, sore throat, etc., and matron arranges for swabs to be taken. The sickness rate used to be high, but is not so high now that there is an eight hour day. All nurses working in the nursery take a ten minute break at 11 a.m. when they have cocoa or milk and a bun in the nursery duty room. The junior nurses sometimes complain about the wearing of masks and head squares but as sister and the staff nurses wear them, they have no cause for complaint.



APPENDIX 3

Aberdeen Maternity Hospital—Statistics relating to mortality rates among premature infants, neo-natal deaths according to day of death, and deaths of infants from infection

TABLE C  
Mortality Rates per cent. in Premature Infants treated in the Aberdeen Maternity Hospital 1941-45  
by Weight of the Baby and the Year

Year	Weight of Infant												Total		
	5½-4½ lbs.			4½-3½ lbs.			3½-3 lbs.			Under 3 lbs.					
	No.	Deaths	Per Cent.	No.	Deaths	Per Cent.	No.	Deaths	Per Cent.	No.	Deaths	Per Cent.			
1941 ...	76	14	18.4	36	14	38.9	11	11	100	28	25	89.3	151	64	42.4
1942 ...	104	14	13.5	41	17	41.5	13	11	84.6	38	30	78.9	196	72	36.7
1943 ...	119	15	12.6	39	17	43.6	10	6	60.0	30	25	83.3	198	63	31.8
1944 ...	65	8	12.3	47	10	21.3	14	6	42.9	17	14	82.4	143	38	26.6
1945 ...	81	4	4.9	39	6	15.4	13	5	38.5	25	22	88.0	158	37	23.4

The table shows that the mortality has fallen in every weight group except in infants under 3 lbs. in weight, where there has been no improvement.

The prematurity rate in 1941 was 8.7 per cent. of booked cases and in 1945 it was 7.8 per cent. The proportion of all premature babies weighing 3½ lbs. or less in booked cases was, for the years 1941-42-43, 27 per cent. of the total, while in the years 1944 and 1945 it was 18.6 per cent. Among emergency cases, however, there was no such change in the proportion of small babies. During those five years the mortality fell steadily from 42.4 per cent. in 1941 to 23.4 per cent. in 1945.



TABLE D  
Neo-natal Deaths arranged according to Day of Death

Years	Time of Death					Total
	Under 3 Days	4-7 Days	7-14 Days.	14-21 Days	21-28 Days	
1941-42-43 ...	103 (67%)	17 (11%)	18 (11.6%)	14 (9.1%)	3 (1.9%)	154
1944-45 ...	54 (81.8%)	4 (6%)	3 (4.5%)	2 (3%)	3 (4.5%)	66

In the years 1944-45, 81.8 per cent. of all the deaths occurred in the first three days before infection could be a factor, as compared with 67 per cent. in the years 1941-43.

TABLE E  
Actual Deaths of Infants from Infection

Years	Total Deliveries	Deaths from Infection		Mortality from Infection Per Cent.
		F.T.	Premature	
1941-43 ...	4,895	10	25	0.72
1944-45 ...	3,156	3	8	0.35

The table shows that in the second period the mortality per cent. had been halved. The results shown may be attributed to better nursing and probably also to improvement in the vitality of the infants.



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